

GRAPHIC SCIENCE

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The Drafting Room*

SEPTEMBER 1960

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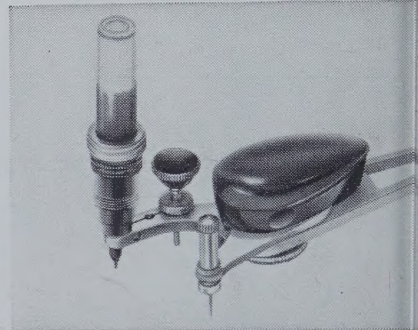
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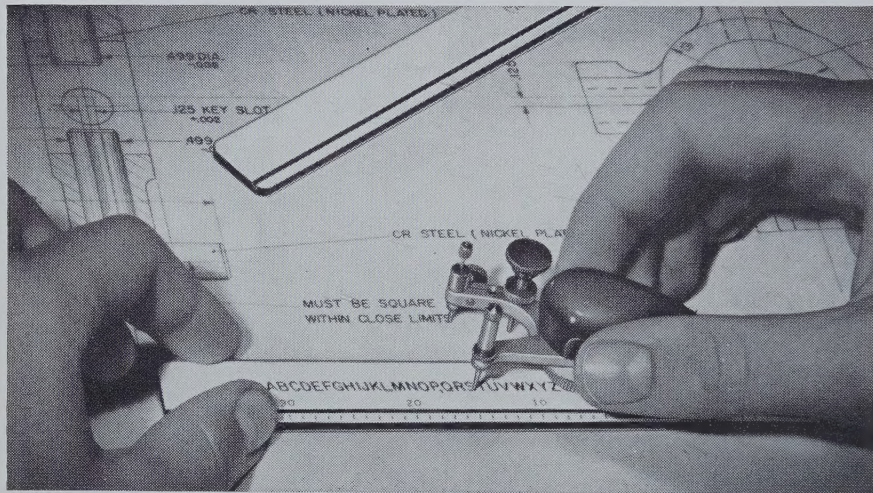
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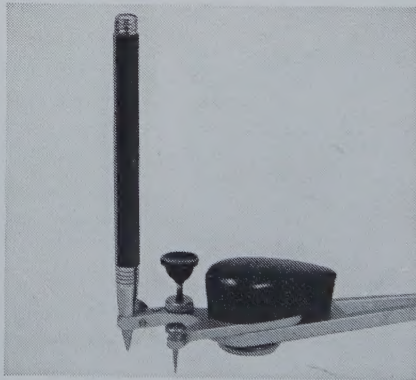
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dulls—it's permanently sharp. And that, we submit, is a pretty sharp idea. The lead of this new pencil is an unvarying .020 inches in diameter, from one end to the other. All that's necessary to repoint is to advance the lead with a turn of the pencil



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GRAPHIC SCIENCE

THIS ISSUE: 12,000 COPIES

SEPTEMBER 1960

VOLUME 2 NUMBER 9

The Magazine of engineering drawing management, covering drafting, reproduction and microfilming, technical illustration, drawing standards and drawing filing in all industries.

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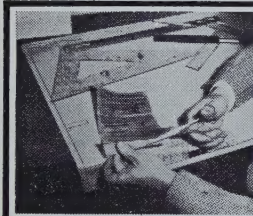
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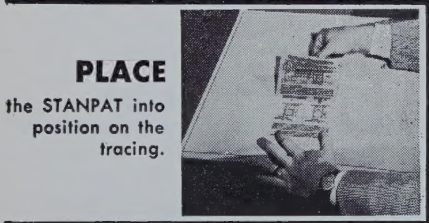


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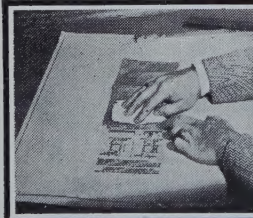
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Letters

Study or Read?

Sirs:

Congratulations for a very fine publication! I have received the May and June issues and feel quite rewarded for the time spent in reading and *studying* the content of each.

Effective Drafting Management is a most important subject to me. May I have a copy of the April issue sent to me? This has the article on E.D.M. Institute and outlines the program. To request a second favor, may I have a reprint of "Recruiting and Training Draftsmen" by L. E. Tep- per?

S. H. PEARSON

Supervisor
Lagging & Electrical Design
Large Steam Turbine-Gen. Dept.
General Electric Company
273 North Avenue
Schenectady 5, New York

EDITOR'S NOTE: *How many other
readers study GRAPHIC SCIENCE?*

Subscription Applications

Sirs:

I am attaching applications for five people who are interested in receiving the magazine GRAPHIC SCIENCE, including myself. We are all Drafting Supervisors, reporting to Mr. D. W. Pegram, Jr. and have read, with much interest, the copies which he has routed to us.

Because of all the interest shown, we intend to make further distribution to all draftsmen in our departments.

A. B. DOORNHEIM

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Chief Engineer

Dear Mr. Markle:

Your letter to GRAPHIC SCIENCE regarding the blueprint reading course interests me.

We have offered such instruction to

any interested people in our area through the Adult Educational Program in the fall and winter. I am the instructor and would welcome any ideas you might have to offer. Could I prevail upon you to send me a copy of your "Lesson Plan and Instructor's Guide"?

In order to set up plans for the next fall session I am writing you direct and sending a copy to our mutual servant, GRAPHIC SCIENCE. As we both can see they make many interested people neighbors, although we are many miles apart.

Your consideration will be appreciated.

Very truly yours,
W. A. SIEGEL

Supervisor, Drafting
Room 15-760 Bldg.
General Electric Company
Richland, Washington
cc: GRAPHIC SCIENCE

Re: The Editor's Board

Sirs:

In "Wanted: Clearer Status" (April 1960), the writer claims to be seeking a *clearer status*, but obviously he is revealing organizational and procedural deficiencies which he is in a position to correct. There is no magic formula for accomplishing this or any worthy objective. But it is possible to do so with the intelligent application of sound business practices. It requires no touch of genius, just good common sense and plenty of hard work.

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Between the Lines

Sirs:

I have just finished reading "Between the Lines" by Robert Howison of King-Seeley Corp. in the June of GRAPHIC SCIENCE. Its very interesting and right to the point as far as we draftsmen are concerned.

Keep up the good work.

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Graphic Perspective

Last month in these columns, "The History of Pencil-Making," Part I, told of the discovery of the famous Borrowdale graphite mine in England in 1565, where the material existed in such pure form as to allow its removal in large slabs. With the working out of this famous mine, the search was on for a way to use powdered graphite for pencil-making. Part II of our guest-written "Perspective," continues the story.—The Editor.

by William E. Danjczek*

THE PROCESS which permitted the use of graphite in powdered form was perfected in 1790. Known as the Hardtmuth-Conte process, it marked the beginning of a new era in pencil-making.

By this method, pulverized graphite was mixed with clay and water to form a paste. Controlling the proportion of graphite to clay controlled the hardness of the lead. While moist, the paste was rubbed into grooves cut in a board, completely filling them. These grooves formed molds for the leads. A second flat board was then laid over the lead mold, firmly

clamped down, and the whole set aside until the leads were dry. In drying, the leads would shrink, so that they readily left the grooves when shaken. They were then subjected to high heat, after which they were ready for their wood cases. All of these leads were square in shape.

Conte is credited with later making round leads by forcing the lead through round holes in metal blocks—the same method, in principle, that is used today.

The early pencil-maker did all his work by hand. He pounded the graphite in a mortar, and sifted it several times to free it of earth and sand particles. He added one-quarter to one-half pound of sulphur (the binder) to every pound of graphite; this was mixed and slowly melted in a crucible. After cooling, and before it was dry, the mass was placed on a board and kneaded. After thorough drying, it was divided with a fine saw into small plates from which four-cornered leads of the desired size were sawed. In wood cut to the necessary size, a groove for the lead was made with a grooving plane, or by burning it out. The lead was then glued into the groove, and a piece of wood glued over it completed the pencil. The end was cut and shaped to a point with a file. The entire surface was then finished by scraping it with glass.

Today the process is similar, ex-

cept for the hand labor which has been considerably reduced.

The introduction of drawing pencils at the World's Columbian Exposition in 1893, marked the modern era in lead-pencil history. Prior to this time, the manufacture of a range of accurately graded degrees of hardness was considered by many to be an impossible and useless procedure. Today it is a generally accepted fact that each of 17 precisely accurate degrees has a definite and useful purpose in a particular field of pen work.

Among the notable refinements of the basic pencil are the mechanical pencil with its propel-repel action, and for the draftsman, the lead holder and lead dispenser.

Hundreds of variations of the simple pencil have evolved. The addition of the eraser, the many multi-colored pencils, and mechanical pencils are but a few of the innovations. The products of the 20th century's high technology are a far cry from the crude chunks of "wad" that English farmers used to mark sheep! Yet the pencil industry rose from the ruins of an ancient oak that blew down in a storm on the English countryside and from the ingenuity of two men, Conte and Hardtmuth.

Illustrations courtesy of Koh-I-Noor Pencil



Early chemist compounding graphite



Cutting a groove for the lead

*William E. Danjczek is president of Koh-I-Noor Pencil Co., Inc., Bloomsbury, N. J., one of the oldest manufacturers of pencils in the world. The company was founded in 1790 by Josef Hardtmuth of Vienna. One hundred years later, the visit of the Prince of Wales to the factory led to the adoption of the name Koh-I-Noor, in honor of Queen Victoria's best known crown jewel, the Koh-I-Noor Diamond.



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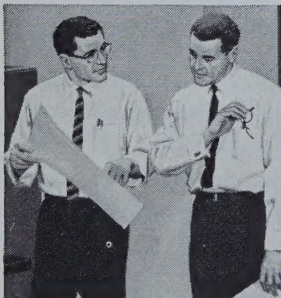
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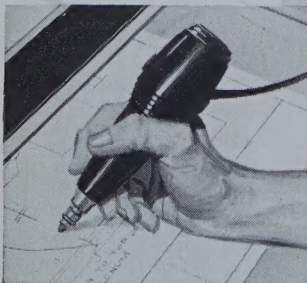
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AOA Meeting

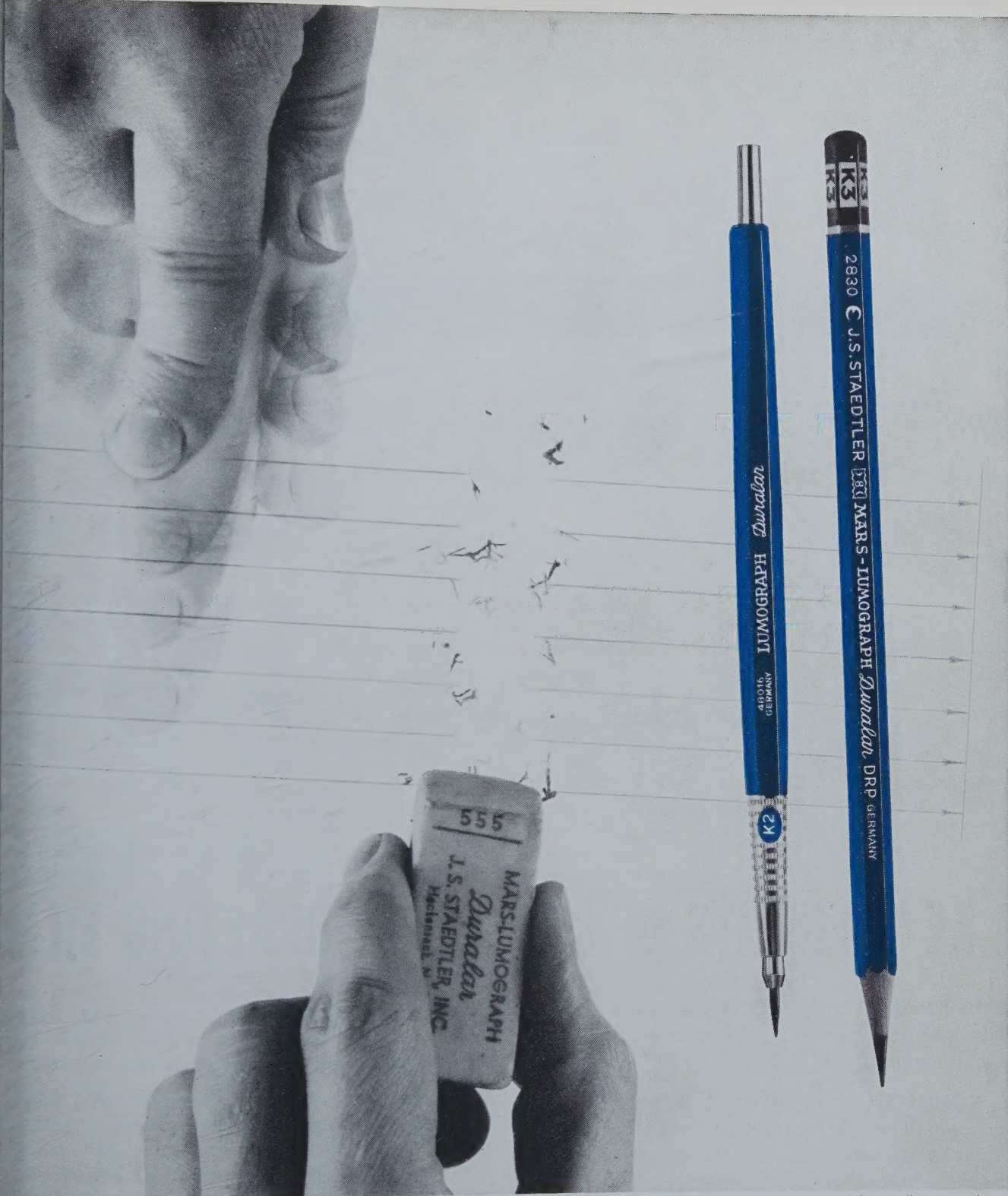
THE ENGINEERING Documentation Section of the American Ordnance Association will hold its Fall meeting at the Boston Navy Shipyard on October 26 and 27. Complete information on this meeting may be obtained by writing to The American Ordnance Association, Munitions Building, Washington 6, D. C.

SES Annual Meeting

NOTE was taken in these columns in July of plans underway for the Ninth Annual Meeting of the Standards Engineers Society, to be held September 26, 27 and 28 at the Statler-Hilton Hotel at Pittsburgh, Penna. Latest intelligence on the technical program indicates a range of subjects of interest to both standards-minded engineers and to management. Papers will be presented on numbering systems for documentation, technical writing as it relates to standardization, organizational structure for standardization, the use of computers in standardization, preparation of standards manuals, and analysis of savings resulting from standardization. Full information may be obtained by writing to the Standards Engineers Society, 1025 Connecticut Ave., N.W., Washington 6, D. C.

ASME Technical Meeting

COMING EVENTS calendar has been released by the American Society of Mechanical Engineers. Nine technical meetings are scheduled from August through the end of 1960; six of these will be held jointly with other societies. Of particular interest to readers of this magazine is the Engineering Management Conference, to be held jointly with the American Institute of Electrical Engineers at the Hotel Morrison in Chicago, September 15-16. Further information on all meetings scheduled for 1960 may be obtained from L. Dennegar, Director of Public Relations, ASME, 29 West 39th St., New York 18, N. Y.



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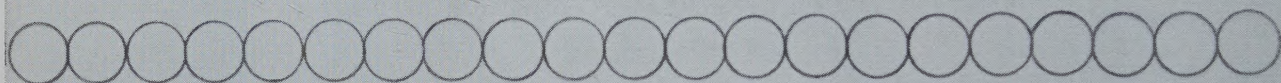
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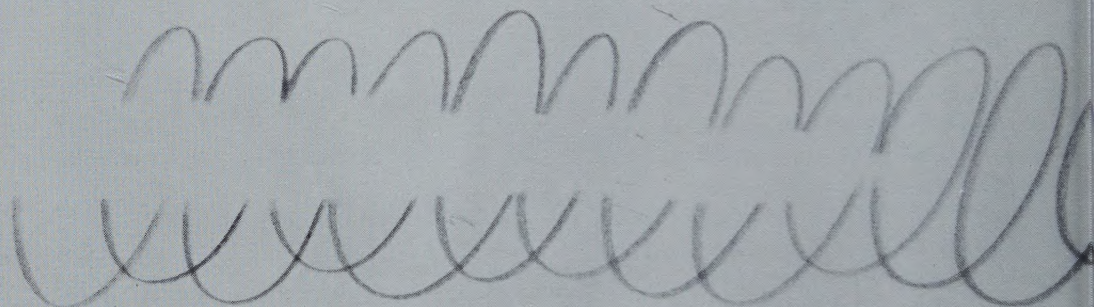
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The Philosophy of Drafting Department Organization

*Some specifics of personnel evaluation, estimates,
the role of the checker, and cost reduction*

by W. W. Thomas

PHILOSOPHY and drafting department organization may not appear at first glance to go together. By definition, however, philosophy is the science which investigates the facts and principles of reality and of human nature and conduct. This will perhaps explain why I have chosen to present some of my personal ideas on specific elements of the problem of drafting department organization, and to call them a philosophy.

If there is a beginning, it must start with men. The men must make the team. You and I, as drafting administrators, are no better than our men. How true this is, and how hard it is to keep it in mind, when faced with design problems, arrangement problems or systems problems. But keep it uppermost, we must.

Our general problem might be stated as one of producing efficient drawings efficiently. Its complexities are many. The making of drawings is a form of art. These drawings must define highly technical items; making them is a science of professional stature, only one step below engineering, for drawings are the language used to express the fulfillment of the sciences.

The performance of a drafting and design department can often make or break the design of the product. It materially affects the cost-profit picture in most industrial applications.

Producing efficient drawings efficiently is the moral obligation of a drafting management. Drawings must be produced with minimum effort in terms of hours spent, confusion, lack of clarity, etc., all the while realizing that they are only the means to an end.

For we must assume that the primary mission of our drafting room is to be of *service* to the Design Productive Elements of our Company. We have no other reason for being. We are the middleman between the dream and the reality. We must produce. What we produce must be usable by all who need drawings. Those who produce must get the conceptual idea into practical reality. This is a service.

Ask yourself, "How many times have I approached my department as an end in itself? How many times have I insisted I be allowed three months to do a job, although the engineer wasn't ready to start and the customer wanted delivery of parts in 60 days?"

First of all then, we must provide the services needed by all those we work for. With that established, we can go to the "how to do it" part of our jobs.

PERSONNEL EVALUATION

PROBABLY the largest single problem faced by Chief Draftsmen lies

in the general area of personnel evaluation. This field covers the actions we take to determine a man's qualifications for his present job and his future advancement. We must do this for applicants and for long-time employees. Determining qualifications implies comparison, and the need for some measuring device, some yardstick. What constitutes the standard of quality in your drafting room? Are these standards of quality being uniformly applied by all of your supervision? Do you have a yardstick? How do you cope with such intangibles as design spec compliance, artistic and language skills? How do you establish history of the man's production and your appraisal of it? Can these histories be related to recommendations for increases, merit reviews, performance analyses, recommendations for advancement?

All of these questions develop the need for a yardstick to measure men. We must be able to measure the appraisal system used. Is it producing the results we want? Does it encourage each man to further improvement? Does it justify advancement of some and retardation of others? In short, does your appraisal system measure up to your requirements as a good manager?

Editor's Note: This article is based on a talk given by the author at the University of Wisconsin Institute on Effective Drafting Management, April 7, 1960.

THE ROLE of statistics in the Chief Draftsman's work is frequently overlooked. While most other specialty businesses have statistical ratios which indicate to their managers the state of the business, I have found the drafting business to be weak in this regard. We seem to feel that our business is different because there are more variables. I suspect that the more variables that exist, the more important it becomes to pin these down and to find out what is happening to them individually and collectively.

What, for example, about the rate of grievance frequency in your department? Is it ascending or descending? Why? Do pertinent statistics point a trend toward an inevitable condition for which you should be preparing? Too often we think of statistics as something to pass on to the boss, instead of as a tool for us to use.

Task analysis is a second large problem for all Chief Draftsmen. How do we establish the requirements for the execution of assigned tasks? We face them in terms of manpower requirements, technical requirements to be accomplished, space and equipment available, and our team's capability to perform the job. One is forced to ask questions in regard to planning the work. We all recognize that there are those who plan too much. This can be as serious a problem as that of being unable to plan.

Accurate estimating is an area that requires constant study and personal surveillance for improvement. Reducing the estimate to the lowest level of unguided judgment is a standard estimating technique which is often overlooked by the fellow who thinks he can estimate a million-dollar job by "the seat of his pants." Do not let the cost-reduction bug bite too deeply. Examine alleged cost-reduction techniques in drafting in light of potential increases in cost elsewhere in the company.

When discussing the measure of cost performance there must be one basic rule applied to our men and to ourselves. We must be constant and honest in our comparison of "actuals" to estimates. I see management as a constant struggle to balance actual performance with pre-established estimates of the same job. Consistently estimating too low is foolishness. Con-

sistently estimating too high is disaster. Consistently estimating "on the nose" is almost impossible, but it should be one of our essential targets throughout Drafting Management work.

Estimating can provide not only a look into the future, but it is also one of the bases for an excellent education program about the past. When I have seen the actual performance compared with the estimates, I have found that no better picture was ever developed of what happened on the job. If we make a sincere effort to identify our mistakes so that we may learn by them, we will quickly find that the same mistake is not repeated. You refine the ability of your staff to estimate, you have historical records on which to base future comparative estimates and you have case study reminders of some of the former forgotten significant points that added up to overrun when the job was worked. You and your team can learn much more through a *post mortem* of actuals to estimates. You must keep these records scrupulously honest and unbiased.

The Chief Draftsman must not, however, lose sight of the overall management picture. I'd guess the largest single gripe heard from Drafting Managers, is about how their bosses cut the estimates. Do I shock you, if I say this is as it should be, and those of us who fail to realize this are making a serious mistake?

Let's compare our top management to the grocer who sets up a loss leader on canned peas for example. The grocer's price is below cost. Is this silly? Not at all. Such things as fiscal accounting, tax writeoffs, heavy local competition, incomplete funding, possible follow-on business, public relations, etc., often involve decisions so subtle or private that they cannot be passed down to us, except as cuts in our budgets. Middle managers, growing in experience are the least likely on the basis of their experience, to understand this. By virtue of their natural aggressiveness, however, they tend to make the most whoop and holler about it. Our ability to absorb this while doing the best we can to meet the targets is part of the measure of our maturity as managers.

Caustic self-analysis, however shows that subtle management is not alone the cause for the cuts made to our estimates. Where this is happening with regularity, we must look for

another cause—ourselves. Estimates consistently high, force higher-ups to apply regular cuts. Top management, by intuition or by guess, is often better at estimating drafting costs than drafting management. This situation, of course, leads to the vicious cycle of padding drafting estimates to offset the cuts made by higher-ups—and around we go.

Look to yourself for the blame here. Statistical proof of correlation of estimates to actuals does wonders to develop your management's faith in your estimates. It is quite easy, over the span of the job, to politely show your boss how his cuts carried the estimates under the actuals. The more accurate your estimates, the more he will rely on them without cuts. It's a hard row, but it is a must for the capable Drafting Manager.

ORGANIZATION OF MEN

ORGANIZATION of men in the Drafting Room must be considered in our philosophy. Why do we have our line and staff organizations? How many of each should we have? Should our staff be isolated to work out the problems or should our leaders do their own staff work? I believe there is no final and complete answer to this problem. I immediately suspect the man who insists on an inflexible formula. The drafting manager, leader, and staff team of the big company must be flexible. Only in this way can the individual capabilities of the men involved be used to best advantage. I know of staff men who have almost zero influence over the line organization. This should not be. I know of line men who influence departments other than their own to such a significant degree that to alter this could be a serious misuse of manpower.

I suggest, therefore, that you stop thinking of organizations only as a chart, and begin thinking of them as a team, where the plays are fitted to the capabilities of the men. Fine, flexible human minds should not be forced into rigid boxes of straight-line organization charts.

No mention of organizational assignment of men should rest without my pitch for back-up men. Here again. I find drafting organizations are serious offenders. Throughout financial, sales, manufacturing, etc., every man has his back-up. Then you come to drafting, and what do you see? One

pany has a 64-year-old Chief draftsman with a 63-year-old back-up. Another has an Assistant Chief draftsman who knows only the office routines but knows nothing of Drafting *per se*. Leaders who have no man they would recommend as their immediate replacement are more common than any of us would like to admit. Every effort must be made to build men into back-up positions, not just by odd chance, but as a daily operating practice.

The organization of a drafting room is an organization of men and an organization of practices; neither should be subservient to the other. Organization of practices means rules. I feel, however, that we must find ways to limit the number of rules we impose in our drafting rooms. Each time a rule is added you must ask yourself, "How does this contribute to my providing the services I'm supposed to supply?"

A classic example of poor reasoning in this area, is being supplied right now by our Federal Government. They say: (1) Our past experience with drawings is that when we microfilm them we can't read the lettering. (2) When we microfilm lettering .22 inches high, we can read it. (3) Therefore, we will make rules about minimum lettering height, style, spacing etc., and solve our microfilm problem. QED

The way I see it, this is illogical. To begin with, we agree that drawings must be legible when microfilmed. So let's make that the rule and stop this foolishness about measuring the height of lettering. I have a personal religion that says, "Blind adherence to a rule is never good drafting department discipline." I feel we must limit the number of rules we impose on our drafting rooms, and support those we do impose with logical explanation of the reason.

Understanding the reason gives our men two advantages over those who follow blindly. First, the likelihood of breaking the rule, intentionally or not, is lessened when it is understood. The second advantage may be even more important, but it is often missed. It is that in the teaching of "why," we provide the man with the ability to adjust the rule to the unusual situation. I am convinced that a simple drafting system, with its reasons completely understood, can outproduce in terms of efficient drawings (even to the military specs if you will) the

most elaborate system backed up by checks and counterchecks.

The subject of organization must include a review of the subject of checking. I know of a number of organizations where checking is not considered necessary. In these organizations, such mistakes as occur are caught by the shop, or by those who process the drawing in planning, or by supervisory review. I cannot completely agree with this, but I do feel it has as much merit as the policy that calls for the 100 per cent detail check. Functional design checks are warranted. Where the Drafting Department is independent of the Engineering Department, this is done automatically through the engineer's review of the drawing. Where the two are tied together closely, some functional design checking is needed.

We must know when to stop. The function checker must not slide into the habit of checking drafting practices, insignificant tolerance build-ups, etc. He must instead limit himself to a check to see that the design will perform, and can be made. To go further allows work of lower order to rob work of higher order.

How do you feel about detail and drafting system checking? I'm against it. Do you shudder? I must, of course, add some conditions, but here is the picture I see. Detailed, 100-per-cent-checking places the responsibility for the details on the checker. Men begin to lean on him. An attitude develops of "Why bother to be sure? The checker will catch it if I'm wrong." This encourages a lack of responsibility. Men can produce quality only to the degree that they individually strive for that quality.

This theory however does not eliminate detailed and drafting system checking. I think checking should be used as a sampling method. From samples of work output we find: (1) individual weaknesses of the draftsman—places where he needs more instruction in what to do or how to do it; (2) repetitive errors the draftsman-designer is making which should be reflected in measuring his value (actual and potential) to the company, or even in disciplinary action; (3) breakdowns in the company's communications system, (we must not blame the draftsman for failure to understand the instructions of a DRM where these instructions are not clear); (4) areas where additional training or instruction are needed.

I feel that checking as a sampling program should be used for all levels of drafting supervision. It should continue to be a sampling, however, with the responsibility for the quality of the work remaining on the shoulders of the man who did it.

Such a policy allows "after release" checking, since it is not the drawing that is being checked, but the man. It allows concentrations for short periods of time on a single problem which may be giving your shop trouble. In my opinion it reduces costs by creating the climate of "do it right first."

It has other advantages too. It makes the checker the first-line of the supervisory team, where I think he should be. He is the first assistant vice president for quality for the group leader. He is the source of information about the quality of a man's work. The diplomacy required, the technical skills he must have, make such a function a natural one from which to develop first-line supervision support.

Much has been said about checkers stagnating in their jobs. I don't think this is necessary at all. Efficiency demands a certain amount of assignment rotation. Special assignment to various levels of review, such as a check to determine how completely a newly issued instruction is being followed, can offer a challenge, and the variety which can eliminate the problem of stagnation on the job.

COST REDUCTION FACTORS

COST REDUCTION is a continuous challenge to the Drafting Organization. If we accept the premise that the Drafting team produces services (this is the way your management looks at it) we will realize why all the pressure to reduce costs.

A few years ago, the *Wall Street Journal* published a headline article which made some sweeping claims about Simplified Drafting. My Vice President sent me the clipping and expected results in 30 days. I have talked to other Chief Draftsmen, and I'd guess the same thing that happened to me happened to thousands all over the country.

We do have a serious problem in this area. Let's look at it. Drafting as a whole does take a big slice of the engineering dollar spent on any project. Product complexity is increasing to a point where some drafting techniques just won't fit the prob-

lem. Side pressures demanding drawings to a quality or system norm keep cropping up. These include such things as the military emphasis on legibility suitable for microfilm, and the industrial use of electronic accounting machines for data processing. Each time some pressure for drawing equalization crops up, the cost of a set of drawings tends to increase.

What can we honestly do to reduce the cost of drawings? First of all, let's be sure of our target. Drawings are part of an operation. They serve the purpose of communicating decisions made in engineering to all who must use this information. Thus we cannot cut the cost of the drawing by reducing the information to be communicated, unless (1) this information was superfluous to begin with or (2) we find a better way of passing it on outside the realm of the drawing.

The simplified drafting that uses legible free hand instead of artistic plots, that uses words instead of extra views, and that eliminates other superfluous delineation is fine. The simplified drafting that codes beyond pictorial comprehension, that demands education and decodification in the shop, is shortsighted. The transfer of costs out of the drafting department into the shop is no saving. So be sure first, that your cost reduction program is not just a "cut down on drafting" program.

Let's discuss some less publicized cost reduction ideas that are valid.

First of all, let's spend our staff work on problem areas. Let's emphasize to our men that they are not to waste time on little problems or on these that don't exist. Measure your own ability along these lines by asking yourself, "How many times this week have I worked out answers where there was no significant problem?" Demand proof of yourself and your people that everything you touch is in fact a problem before spending time working out the solution. Sort them out on the basis of whether the problem justifies the effort before you do actual work instead of recognizing after you are three-quarters finished that there was no need to have done the work anyway.

Second, how about a single drafting standard? How many of us truly appreciate the lesson to be learned in the shape of a learning curve? Its message is simple. A new way of doing things is severalfold more costly

than doing the same thing once it has been learned. I know of a company where five different projects are in work in the same drafting department, and those projects all have different drafting practices.

How can we cut costs in these cases? We must set up efficient minimum standards, and then with whatever force it takes hammer these home to our management as the only way we can tackle a job. We must get drafting work out of the steep part of the learning curve, and into the flat. Once we do this all our project engineers will save time and dollars.

Third we have to keep on top of new techniques. I'll mention only a few of those which involve overall savings to the company. Notice that I do not say savings to Drafting, since I'm convinced that good management couldn't care less about my increasing my costs \$100,000 per year if I reduce someone else's by \$200,000. Areas I think we might keep our eye on include (1) computer-prepared tabular drawings such as wire interconnection lists and cabling drawings, (2) computer-controlled machinery, (3) undimensioned drawings for a host of things including sheet metal parts, stencil drawings, nameplates, printed circuitry, insignia and marking instructions, (4) reproduction techniques that allow building of a new drawing from elements of an existing one, (5) EAM (electronic accounting machine) preparation of parts lists, and (6) photographic drawing techniques.

Fourth, we have to improve our communications system, up and down. How many of us know exactly, how well we get new instructions or requirements across to our men. The advertising business could teach us a lot in this respect. They make it a point to know how effective their message is. In this way, they then get to know the most effective methods of how to communicate. Then they use them. It's a constant evolutionary circle: select the method, communicate the message, check the results, select the method on the basis of the results and so forth. Why shouldn't we use this technique?

Fifth, teaching is saving. How hard it is to keep this point in mind. As administrators we must consider ourselves teachers. Every step of growth must be taught, using every modern approach we can. Good teaching can reduce costs in the drafting

room. But a word of caution. Don't plow forward to your director or training and hand him a lump of money to do the job. Somehow or other I have never seen the formal classroom technique work for this type of training.

Here is how I have found it can work best. Teach the supervisors how to teach—the training department may help here, if you keep hammering at them to stay on the track. Then let the supervisors teach the men in short bursts. Concentrate discussions on a single point, spend one-half hour or less on it. Evolve enthusiastic support from the natural leaders.

A sixth and final suggestion for cost saving might be to control your incremental expenditures. I'm convinced that Parkinson's Law is real. Work does expand to fill the time available to do it in. Thus the supervisory team must exert regular steady pressure to keep expenditures on the track. This should be no special campaign. This must be a steady, deliberate, and fair effort. Here your actions speak louder than words. Some of the things that spell out a sloppy attitude toward costs are: (1) meetings which get side tracked into bull sessions or even into other business than for which they were called; (2) supervisors who slip back late from lunch; (3) schedules and budget reports which run several weeks late; (4) drafting system errors which are allowed to go uncorrected because "we don't have time to fix it right now"; (5) exceptions to rules which are easily obtained, are not recorded or worse still, are not even discovered except by accident; (6) good men who are consistently working below their capacity.

This then, represents a part of my Philosophy of Organization for Drafting Rooms. It is ever-changing. It grows as I grow. I hope it has given you cause to think about your own philosophy. If it has, fine. I would certainly like to hear from those of you who find I'm way off the track.

The Author

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Lighting and Air Conditioning

A report calculated to stimulate thinking toward an integrated environment in drafting rooms — proper lighting plus efficient heating and cooling

by W. S. Fisher and J. E. Flynn

The Illuminating Engineering Society recommends 200 footcandles of light for drafting rooms. Lighting experts at General Electric Company's Nela Park tell us that they know of no drafting room with this level of illumination. We invite our readers to report on the matter.—The Editors.

WELL PLANNED lighting can minimize fatigue and increase productivity. In drafting rooms, as in other areas where good "seeing" is essential, the trend is toward higher levels of illumination. We have now reached a point where the value of lighting can no longer be judged as an independent factor. It must be considered as an integral part of a comprehensive system for controlling interior environment—a system that integrates lighting, heating, and cooling. Some of the fundamental aspects of electric lighting as a heat source are discussed below.

HEAT FROM HIGHER LIGHTING LEVELS

AS THE TREND toward higher lighting levels has developed over the years, constant improvement in lamp efficiency (notably in that of the fluorescent lamp) has permitted increased illumination with little effect on room temperature or occupant comfort. This situation is changing, however, now that the need for increased quantities of light is being accepted generally. Higher concentra-

Editor's Note: This article is based on the paper, *Integrated Lighting-Air Conditioning Systems*, presented by the authors at the National Technical Conference of the Illuminating Engineering Society in September 1959. A condensed version of this paper subsequently appeared in *LIGHT Magazine*, publication of the Large Lamp Department, General Electric Company, Nela Park, Cleveland, Ohio.

tions of electrical energy are inevitable—not only for lighting, but for business machines and other equipment. The increased heat that results must be removed or neutralized before it can affect occupant comfort or reduce the efficiency of the mechanical and electrical parts of the systems serving the area. This objective must be achieved with minimum expenditures of energy, equipment, and space.

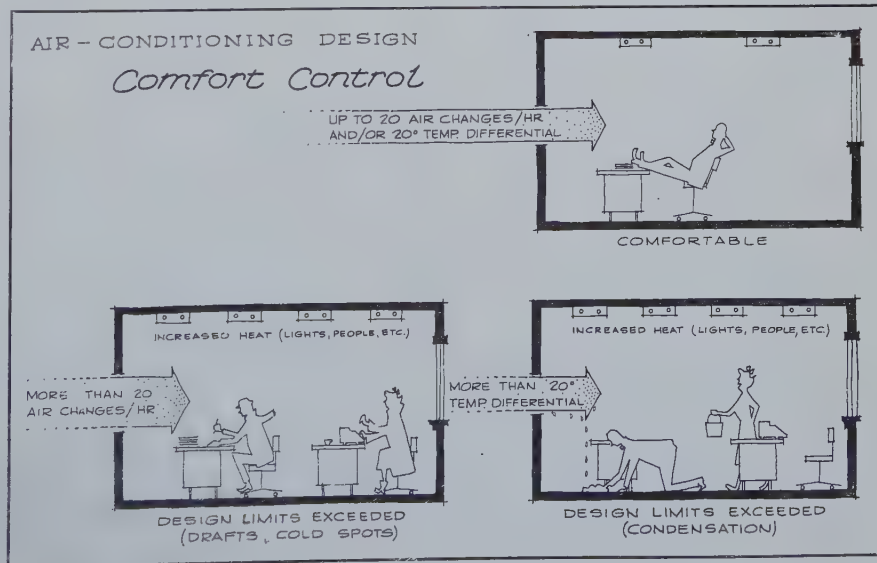
Conventional air-conditioning techniques are being used successfully today in conjunction with many higher-level lighting systems. To handle the additional heat generated by the lighting, the designer plans for added capacity, and increases the amount of air moved through the space (more air changes per hour), or lowers the temperature input air (increases the temperature differential). Both these techniques have limitations, however, that diminish their effectiveness when high concentra-

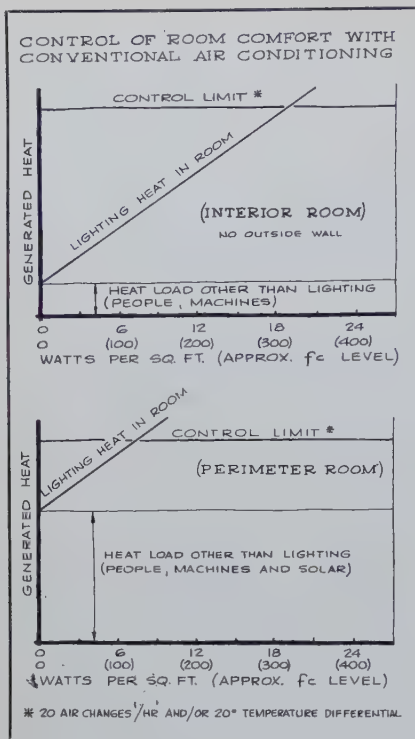
tions of heat are involved.

The techniques of increased air flow up to about 20 air changes per hour is accepted practice. When this limit is exceeded, there may be drafts and cold spots in the occupied area. Furthermore, the other technique—that of introducing colder air—will eventually cause moisture condensation on ducts and air diffusers. This condition establishes the limit of approximately 20 degrees temperature difference between the cooled input air and the air in the room.

In relating air-conditioning limitations to lighting levels, it is apparent (see diagram) that conventional techniques can neutralize the heat from several hundred footcandles—in addition to removing the heat generated by people and office machines. Although this is considered a realistic appraisal for an interior room, it does not include an allowance for solar heat, and the heating effect of outside

Illustrations courtesy of *LIGHT Magazine*.





walls in warm weather. With the use of extensive glass areas for exterior walls, the effects of solar heat increase the load on the cooling system. This increased heat, like that from the lighting, must be neutralized.

In some cases then, we have interior spaces where the heat from 200 to 300 footcandles is easily controlled with conventional cooling techniques, while in the perimeter rooms, solar heat places an additional load on the cooling system. As a result, only a fraction of the heat in the room can be neutralized without exceeding the limitations of a conventional air-conditioning system.

To achieve the lighting levels desired, techniques must be devised for removing and utilizing lighting heat more economically. This requires some understanding of basic characteristics of heat transfer, and an appraisal of the lighting system as a supplementary heat source.

FUNDAMENTALS OF HEAT TRANSFER

H EAT always flows from a warm object or surface to a cooler one. This flow continues until a neutral or equal temperature condition exists between the two. Because a lighted lamp is warmer than the surrounding air, and warmer than the body surface of a human being, thermal gradients develop, and a flow of heat results. Under extreme conditions, this heat can produce consider-

able discomfort for the individual.

The body also loses heat to cooler surfaces (windows or outside walls in winter) and to cooler air. This transfer of heat cools the skin, and sometimes this causes discomfort. A major objective in air-conditioning design is to neutralize the thermal condition in the room to prevent discomfort from either excessive heating or cooling.

Essentially, heat transfer from a lighting system to cooler areas or objects takes place in two ways. *Radiant* heat follows the same path as light. It is short-wave, infrared energy that passes through both glass and air with little absorption. When it strikes a person, surface, or object it is absorbed or reflected (in much the same manner as light) and a sensation of temperature rise results because of absorbed energy.

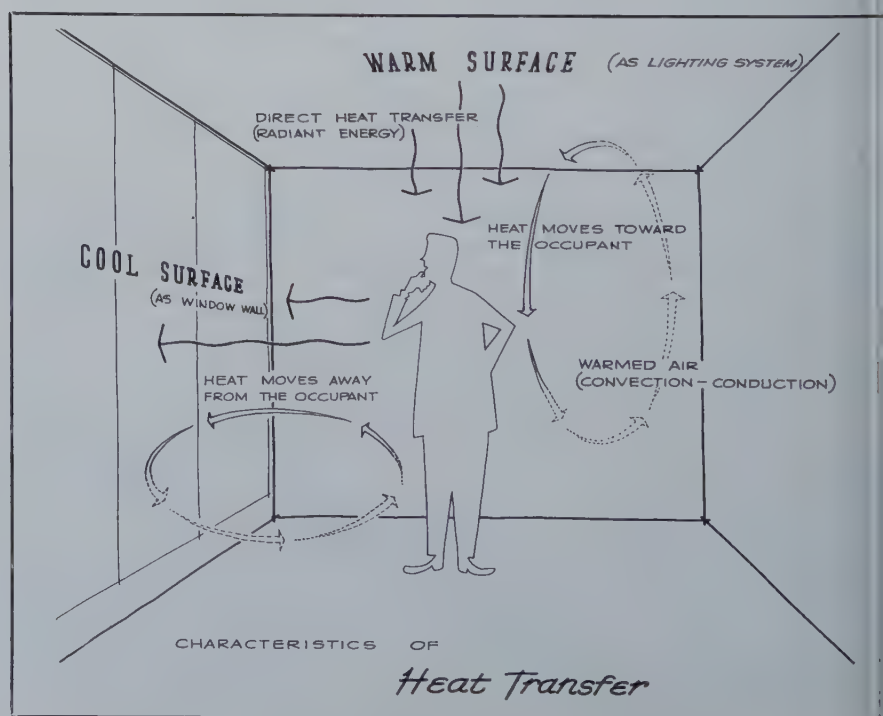
This type of heat is difficult to neutralize or eliminate by means of conventional air-conditioning or air-circulation methods, because the transfer of heat is directly between two objects or surfaces rather than to the surrounding air. Control of this type of heat depends upon techniques that reduce the temperature gradient between the two surfaces involved. This can be done, to some extent by cooling the surfaces of lighting equipment or by modifying the concentration of radiant energy.

The second type of heat transfer does respond to conventional air-conditioning or air-circulation methods.

Conducted-convected heat is transferred from a hot object to the surrounding air (conduction). The warmer air then moves by gravity or circulation (convection) to a cooler object where heat is again transferred (conduction), warming objects, surfaces, and occupants within the room. Because the flow of air currents is the key factor in the transfer of this heat, the *controlled* flow of heated air—keep it away from people in the room in warm weather, or to utilize it more efficiently in cold weather—is the objective of integrated systems.

THE LIGHTING SYSTEM AS A HEAT SOURCE

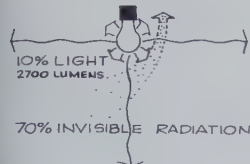
T HERE ARE fundamental differences in heat characteristics of incandescent and fluorescent lamps. A comparison of lamps having approximately equal light output (150-watt incandescent, and 40-watt fluorescent with ballast) is shown in the drawings. Remember that the fluorescent lamp has approximately three times the luminous efficiency of the incandescent lamp, and therefore produces only about one-third the heat per lumen. This difference in wattage accounts for a substantial difference in the amount of total heat produced—a factor that is not indicated on the drawings. About one ton of cooling required to remove the heat from approximately 3500 watts of lighting, regardless of the type of lamp used.



TOTAL ENERGY

ENERGY CONFINED IN LUMINAIRE

20% CONVECTION-CONDUCTION



5% LIGHT
35% INVISIBLE RADIATION
20% CONVECTION-CONDUCTION



5% LIGHT
35% INVISIBLE RADIATION
LUMINAIRE EFFICIENCY 50%

ENERGY ENTERING OCCUPIED SPACE

ENERGY OUTPUT FOR 150-W

Incandescent

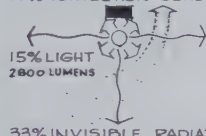
LAMP

COMPARE the total energy output of incandescent and fluorescent lamps — alone and in fixtures. Note that in a fluorescent luminaire having 50 per cent efficiency, more than three-fourths of the lighting heat is initially trapped or absorbed by the lighting unit itself. If this heat is not removed or controlled, it moves by convection-conduction or re-radiation to adjacent ceiling surfaces and cavity, and eventually enters the room. If this heat is drawn off before it enters the room, it is easier and less expensive to maintain room comfort. Recirculated in cold weather, lighting heat can supplement the heating system.

TOTAL ENERGY

ENERGY CONFINED IN LUMINAIRE

11% BALLAST
41% CONVECTION-CONDUCTION



33% INVISIBLE RADIATION

7.5% LIGHT
11% BALLAST
16.5% INVISIBLE RADIATION
41% CONVECTION-CONDUCTION



7.5% LIGHT
16.5% INVISIBLE RADIATION
LUMINAIRE EFFICIENCY 50%

ENERGY ENTERING OCCUPIED SPACE

ENERGY OUTPUT FOR 40-W

Fluorescent

LAMP AND BALLAST

The amount of air used for these purposes amounts to about one-third of the total waste air available. The remaining two-thirds can be put to use by exhausting it through the lighting system — removing part of the lighting heat in the process. Because the replacement air is already accounted for as a normal ventilation requirement, an appreciable increase in lighting load is possible with no effect on cooling requirements.

Ventilated lighting systems remove heated air from around the lamps. As a result, lamp efficiency improves. For example, a T-12 fluorescent lamp, operated at 430 ma in motionless air and a 100°F ambient, produces about 12 per cent *less* light than the same lamp at 77°F. Many lighting systems produce ambient temperatures of 80°

With the initial advantage of better efficiency, the fluorescent lamp has been the most logical choice for obtaining higher levels of general illumination, and it is the most economical light source for air-conditioned spaces.

The analysis of lighting heat cannot stop here, however, for a well designed lighting system rarely consists of bare lamps. Therefore, it is necessary to understand the heat-emission characteristics of the lamp - fixture combination if we are to see how lighting and air-conditioning can be integrated efficiently and economically.

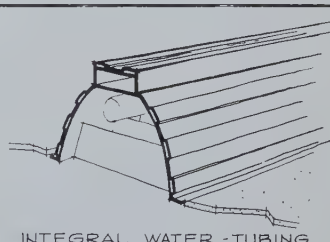
ROOM COMFORT

THE USE of ventilated lighting systems seems to offer potential advantages in reducing the heat in the room. In effect, this is an answer to the design limits of the air-conditioning system — the restricting factors of air velocity and input air temperature. As shown in the drawing, the reduction of lighting heat *in the room* permits an increase in lighting load without affecting occupant comfort.

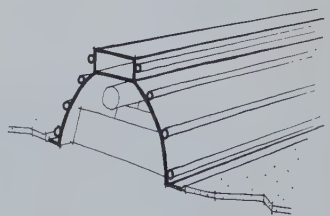
Although maintaining room comfort is certainly the initial purpose of air-conditioning, the practical consideration of economics is no less real. It is obvious that additional lighting heat adds to the cooling load.

Estimates based on conventional air-conditioning practice indicate that in office buildings where about 100 footcandles of general illumination are provided, heat from the lighting accounts for approximately 35 per cent of the total cooling load. If the lighting level is increased to 200 fc, the resultant heat accounts for about 55 per cent of the total load. Because this is the general range of lighting levels in buildings that meet current lighting standards, system design refinements that might reduce the effect of these levels of illumination on total cooling requirements are an important economic consideration.

Building codes specify the ventilation requirements for each type of area — auditorium, office building, store, etc. As a result, a number of engineering firms design for approximately 25 cfm of fresh air for each occupant of a large office building. They assume an occupancy of one person for each 100 square feet. This quantity of fresh air introduced into the system requires the removal of an equal amount. Some of the waste air is exhausted through toilet rooms and service areas. An additional small amount is used for building pressurization — to maintain a slightly higher air pressure inside the building so as to reduce the infiltration of air and dirt through cracks, etc.



INTEGRAL WATER-TUBING

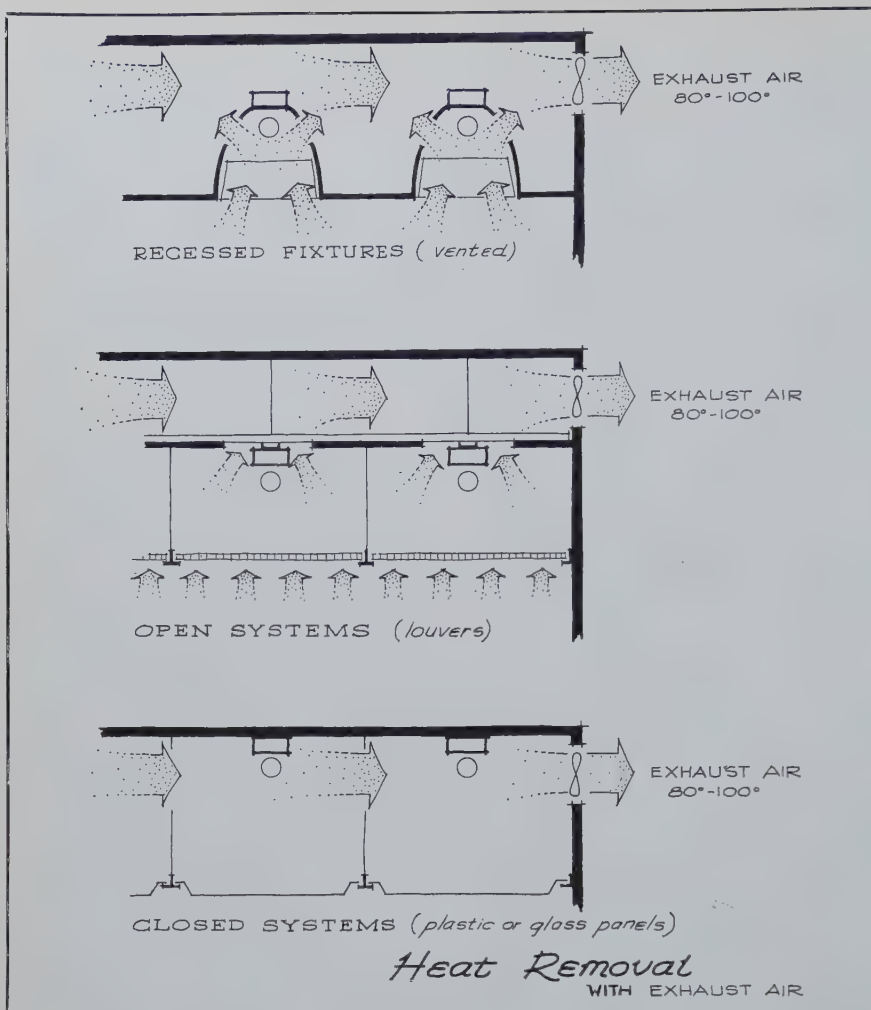


EXTERNAL WATER-TUBING

Heat Removal

WITH CIRCULATING WATER

A SUBSTANTIAL amount of heat can be removed by water circulated through the system — possibly by means of tubing integrated with the luminaires. Total air circulation can be reduced, but ventilation air is still necessary to meet building code requirements.

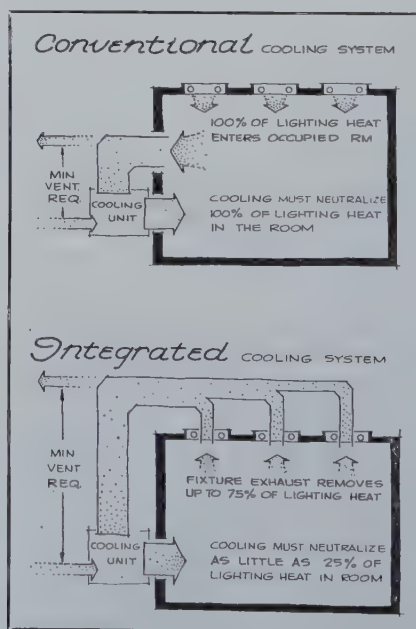


AIR from the room can be exhausted through the luminaires or cavity to draw off substantial quantities of heat. Because this heat is prevented from entering the occupied part of the room, the requirements for maintaining room comfort are reduced.

to 100° or higher. Therefore, it is desirable to remove this heat so as to achieve maximum efficiency of the lamps, and to obtain the lighting level for which the system was designed.

UTILIZING LIGHTING HEAT

THE INFLUENCE of lighting heat on the total heating system capacity required for a building varies with the lighting level, the type of light source, the efficiency of the lighting system, and the design of the building. Air, heated by the lighting system to 80°-100°F could, if properly controlled, become valuable in cold weather in helping maintain a room temperature condition of 70°-75°F. A system of distribution is also required. As the weather moderates, a thermostatically controlled mixture of outdoor and recirculated air offers additional advantages in maintaining room comfort.



THE DIAGRAMS (right) are the same as those shown on page 16 except that a line has been added to show the effect of reduced lighting heat in the room itself. Reducing the quantity of heat in the room reduces the demand on the air-distribution system. With integrated systems, lighting levels can be increased without "pushing" cooling system operation beyond the limits of comfort and efficiency.

With lighting heat available as a supplement to a heating system, reductions in capital investment for boilers, chimneys, and long distribution ducts are possible.

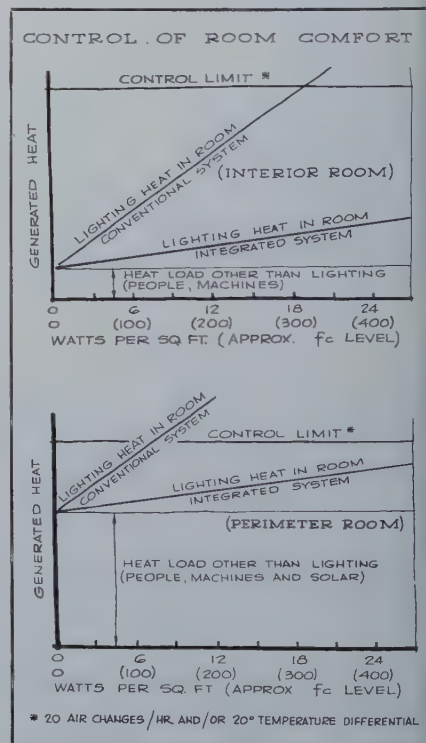
Today we have many 100-fc and 200-fc lighting installations—in some cases lighting levels are even higher. For the most part, the areas these serve are air-conditioned in the conventional manner. They are operating satisfactorily, and by today's standards they are considered practical and economical.

As the demand for higher lighting levels increases still further, however, integrated lighting and air-conditioning systems should offer substantial advantages in comfort, performance and economy.

The Authors

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Revolution in the Drafting Room

Studies show that comfort and convenience of the draftsman are not paternal or charitable considerations on the part of management

by Win Straube

The young lady with her feet in the air (above) serves to dramatize the fact that physical discomfort need no longer be accepted as one of the job conditions in the drafting room
—The Editors.

IDEAL WORKING conditions are influenced today by concepts of pushbutton convenience, streamlined office design, air-conditioning, sufficient lighting, and effective noise control. The picture comes to mind of a charming young receptionist seated in the beautiful outer office of a large corporation. A comparable level of attractiveness and convenience may be found also in the offices of many executives, and in certain other office departments.

This description, however, will not apply in most cases to the drafting room of that same large corporation. While good product design may be the firm's greatest asset, management often regards the drafting department as a necessary evil and a financial liability. This lamentable attitude exists despite the fact that the drafting board is the battleground where the corporation will map its victory or defeat; the best sales department won't be of much help if the product is badly designed. At a time of stiff world market competition, the battle can often be won with a better design.

And better design consists of resourceful thinking, precise work, and speed.

The automobile assembly lines in Detroit have undergone many changes since their inception. But many drafting offices across the United States are still using the same methods and equipment that prevailed 30 years ago.

Changes require facts—and courage! Here then, are some facts about the relation of equipment to drafting efficiency.

EQUIPMENT

SYSTEMATIC investigations carried out by Batelle Memorial Institute of Columbus, Ohio, revealed a direct relation between equipment and output; see diagram overleaf. Under carefully controlled test conditions, Batelle researchers found that the type of tools employed (T-square, parallel rule, or drafting machine) and the type of drafting board worked on (horizontal or adjustable) were important factors in drafting efficiency.

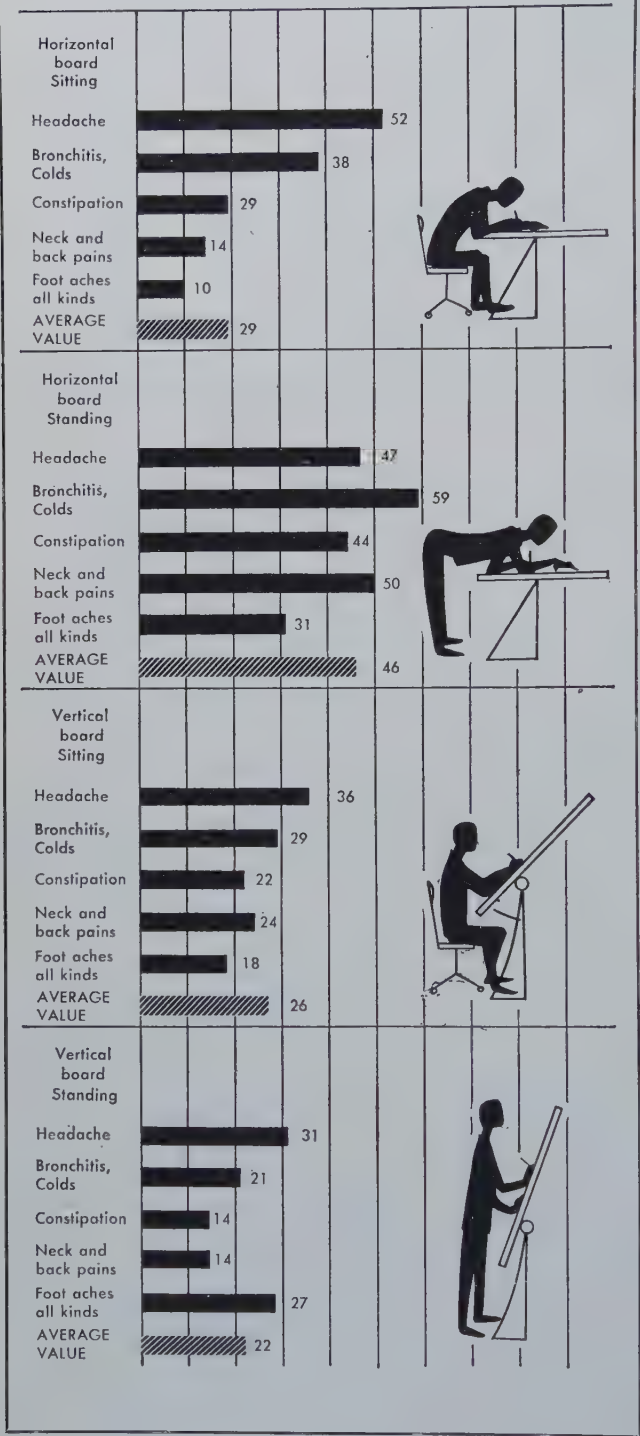
Since there is no "average" draftsman, insofar as height and working habits are concerned, the drafting table is not sufficiently flexible if it is fixed at an "average" height and angle. If he has a choice, the draftsman will select a working height and angle which is comfortable for him, al-

though it may be a considerable departure from the "average." Since no standard table can be established for all, the ideal table must allow adjustment. The board height and angle will differ widely for each worker; it will vary still further during the course of the day, as the worker assumes positions which are comfortable and easy for him. The selection of a flexible drafting table, therefore, is essential to the working comfort of the draftsman.

Much effort has been expended, by architects and designers alike, to provide convenient and purposeful chairs for all occasions. These designs were probably conceived by individuals who were themselves seated on high stools—one of the most uncomfortable pieces of furniture ever invented, and certainly outdated in view of modern seating.

The comfort of any sitting person will be greatly increased if he can sit on a comfortable chair with backrest, his feet touching the floor. For use with such a comfortable and natural sitting position, the drafting table must be designed in such a way that it can be adjusted easily, and each part of the board must be accessible from a comfortable seated position. Does this sound like an unattainable Utopia? It isn't, as a conference with any drafting room furniture supplier

Fatigue vs. Sickness Rate in the Drafting Office in Per Cent

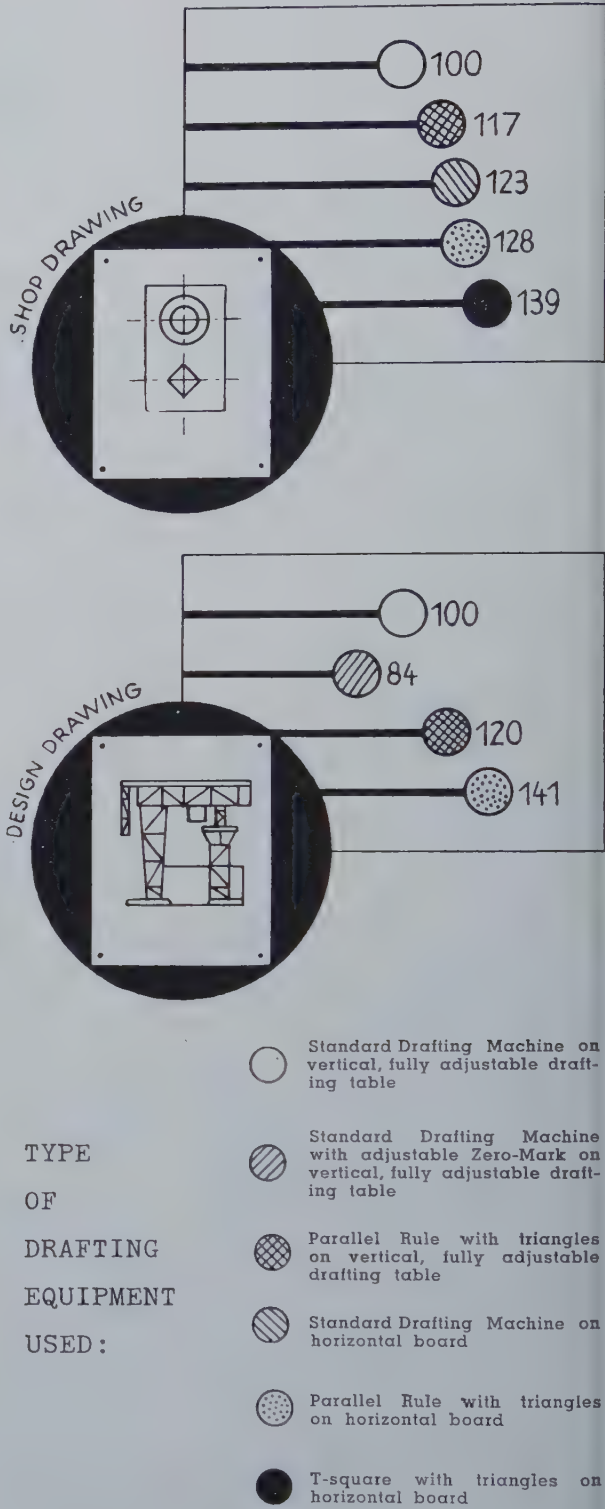


will quickly confirm.

The importance of the drafting machine should not be overlooked either. The diagram above shows how much time can be saved with drafting machines. Although it may be hard to break the long-time habit of

using T-squares, properly used drafting machines are a real time-saver. It may, however, be advisable for drafting management to make sure that each draftsman understands the operation of his new machine, and takes his time getting accustomed to

Working Time in Per Cent

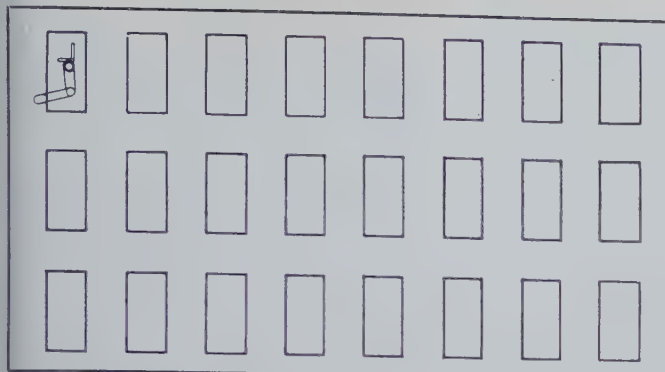


TYPE
OF
DRAFTING
EQUIPMENT
USED:

Statistics are from Batelle Report on drafting efficiency and fatigue.

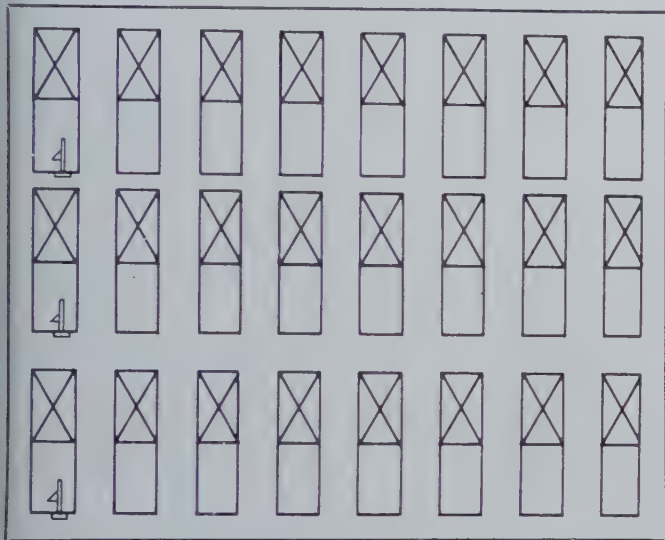
it; otherwise, he may indeed be fast with a T-square!

Just as important as comfort seating and working positions is comfort for the eyes. Lighting conditions have been found to be best if 150-foot candle light is available on drafting



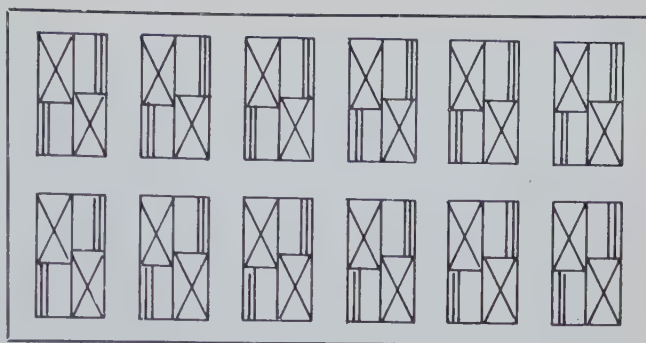
Space required for 10 drafting units530 sq. ft.
 Drafting board size per unit 18 sq. ft.
 Reference area per unit 0 sq. ft.

CONVENTIONAL DRAFTING ROOM SET-UP with horizontal boards, drafting machines — no reference tables.



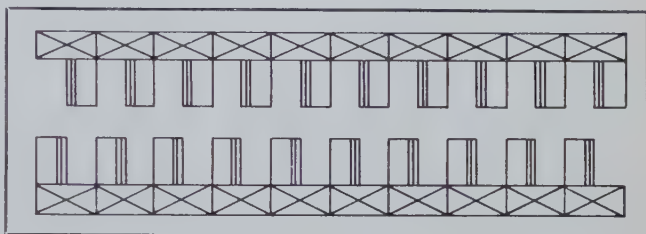
Space required for 10 drafting units740 sq. ft.
 Drafting board size per unit 15 sq. ft.
 Reference area per unit13.4 sq. ft.

CONVENTIONAL DRAFTING ROOM SET-UP with horizontal drafting boards with T-square and reference tables.



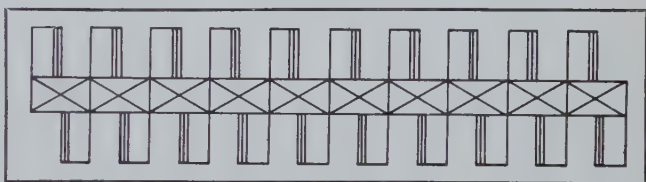
Space required for 10 drafting units485 sq. ft.
 Drafting board size per unit12.5 sq. ft.
 Reference area per unit 13 sq. ft.

DRAFTING ROOM SET-UP with adjustable drafting units^{**}; drafting board size 36" x 50", plus reference area 31" x 61".



Space required for 10 drafting units455 sq. ft.
 Drafting board size per unit12.5 sq. ft.
 Reference area per unit13.1 sq. ft.

DRAFTING ROOM SET-UP with adjustable drafting units^{**}; drafting board size 36" x 50", plus reference area 31" x 61".



Space required for 10 drafting units386 sq. ft.
 Drafting board size per unit12.5 sq. ft.
 Reference area per unit 7.6 sq. ft.

DRAFTING ROOM SET-UP with adjustable drafting units^{**}; drafting board size 36" x 50", plus reference area 36" x 61".

boards where rough drafting and layout work is being done, while 200-foot candles are recommended for detail and cartographic drafting work.^{*} These recommendations, of course, will also vary with the type of work and the material on which the draftsman works. Nevertheless, if the number of draftsmen in a given area is increased, the lighting will, in all probability, have to be moved and increased also. If the eyes are at ease—not combatting glare, and dark spots—then fatigue is less likely to occur.

COST ANALYSIS

DRRAFTING costs can be reduced if present costs are seriously analyzed

^{*}Editor's Note: Elsewhere in this issue, lighting experts from General Electric Company's Nela Park discuss the trend toward "daylight" lighting and how it can be obtained.

and if each one is examined individually. This procedure, actually should be followed every six months, since changes creep in unnoticed. A variety of excellent publications are available on Functional Drafting.¹ Drafting supply distributors are glad to assist in suggesting appropriate literature. Manufacturers of all types of drafting room equipment will supply information. These manufacturers usually conduct their own tests; they also employ research institutes to work on cost reduction problems to promote a new product.

¹The Industrial Education Institute, 221 Columbus Avenue, Boston 16, Mass., has published a series of books on Functional Drafting which are available for one dollar each.

The United States Superintendent of Documents, Washington 25, D. C., has a book available for 15¢ on Functional Drafting (NAVSHIPS 250-520-6, revised November 1957).

Better working conditions and applied cost reduction procedures that mechanize the non-creative elements of drafting will also tend to attract more and better students to the design profession. There has been a tendency on the part of bright young engineering students to shy away from the design field because of its widespread reputation for awesomely repetitious work, miserable working conditions, and lack of the prestige present in other engineering jobs. This should not and must not be so. Good design means first-rate designers. High salaries are one way of attracting good designers, but better still is the creation of conditions for success. "Man does not live by bread alone," especially in the design field.

^{**}Kuhlmann Drafting Units.

SAVINGS in floor space will be realized at no cost if use is made of proper equipment, proper lighting, and the ideal working conditions we have been talking about. The arrangement of drafting tables in L-shape—or in other space-saving ways—will give the individual more drawing area, more reference area, and more privacy. At the same time, it will reduce the over-all floor area required. The suggested drafting room arrangements shown are layouts which save floor space. The advantage of this type of arrangement (i.e. separate drawing tables and reference desks) is that it can be easily changed if required, and as we all know, the drafting department undergoes many changes from time to time.

Under normal operating conditions, and without crowding, it is realistic to think in terms of 50 to 75 square feet for each draftsman; when necessary, the square footage per man may be reduced to about 40 feet for a limited period of time. Some companies have actually paid for their modern drafting equipment by reducing their area rental requirements. If the area required for the drafting activity can be reduced, the rental funds saved may be applied to the purchase of equipment.

The photograph on this page shows the drafting office of the Mathews Conveyor Company, where 40 per cent of floor space was saved

by the introduction of new equipment. Before the changeover, their layout consisted of fourposter flat drafting tables grouped together in the best possible way in a large drafting office. Each man had his board for drawing, for keeping reference materials and for storing drafting tools. To save costs, these fourposter drawing tables were converted to reference tables; this was accomplished by sawing six inches from the legs to make them a normal desk height. Two rows of these reference tables were put together, separated by a partition. Each draftsman now has a reference desk of his own, and a counterbalanced drafting table with machine—for drawing only. Each draftsman now sits on a comfortable chair. In addition to the 40 per cent floor space savings, the morale of the drafting office was greatly improved, the noise level is down, and efficiency is up.

A man will feel better and work better if a minimum of privacy and convenience is allowed him. Drafting supervisors should not hesitate to approach management with facts. The cost of the equipment required to modernize a drafting room must be equated with the value to be derived from it. The benefits realized from proper equipment often equal, and sometimes exceed, the cost. Depreciation rates compare favorably with those of other office equipment, where a larger investment is usually required for less gain in efficiency.

HEALTHIER working conditions, more space, and increases in efficiency in the drafting office are made possible by the following.

1. Creating ideal working conditions:
Easily adjustable drafting tables
Separate reference desks
Comfortable chairs
Sufficient light
2. Investigating cost-reduction factors:
Standards
Flow of materials and information
Methods of design
Functional drafting
Reproduction
Storage of data
3. Saving space through functional drafting room layout
4. Attracting students and engineers of high calibre through creating the right working climate and providing opportunity for advancement

The shape of things to come is in the minds and hands of our designers. Their responsibility must not be taken lightly. A whole nation—perhaps a whole world—depends upon them. Isn't it time for a revolution in the drafting room?

The Author

WIN STRAUBE is vice-president and executive director of Kuhlmann Straube Company Ltd., of Oakville, Ontario.



DRAFTING ROOM of Mathews Conveyor Co., where 40 per cent floor-space-saving resulted from introduction of new equipment.

Spring Drafting Principles

Part IV

Spiral Springs and Constant Force and Torque Springs

by Albert L. Godshall and Gerald L. Kilmer

SPIRAL SPRINGS (Figure IV-1) are similar to helical torsion springs, except that succeeding coils lie in the same plane and have gradually increasing radii. They exert torque about the axis of winding.

Since each spiral spring is unique, there is no recommended specification form for verbally specifying the spring. Therefore, a spiral spring drawing requires full dimensions and notes.

The "Spir'ator" (Figure IV-2) is a prestressed spiral spring which resem-

bles the spiral spring in appearance and operation. Instead of being prestressed to form a reverse spiral, the "Spir'ator" spring is initially prestressed to form a tight coil. The outer end of the coil is reverse bent and fastened to the arbor; the inner end is fastened to the case. There is no recommended specification form for the "Spir'ator"; thus it should be drawn fully dimensioned.

It is not necessary to draw every coil in a spiral spring. The first and the last one-and-a-half turns are usually sufficient. However, the ends must

be drawn.

The drawing should show the means for attaching the spring to the arbor, and the method of attaching the outer end.

Other necessary dimensions include: the ID, OD, and the size of arbor.

In drawing a spiral spring, a two-point spiral is sufficiently accurate for all practical purposes. A more accurate spiral could be drawn by giving four center points for each revolution. However, this is not going to help the spring manufacturer make a better spiral spring.

Illustrations courtesy of Hunter Spring Co.

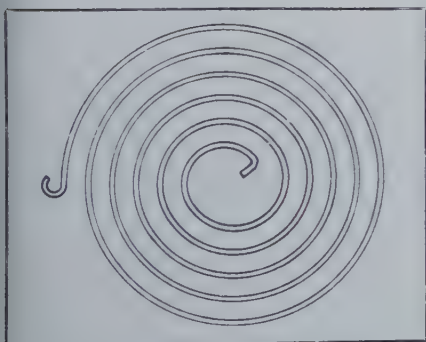


FIGURE IV-1. Spiral Spring.

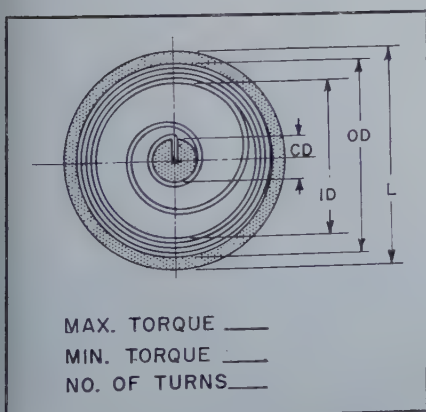


FIGURE IV-2. Spir'ator.

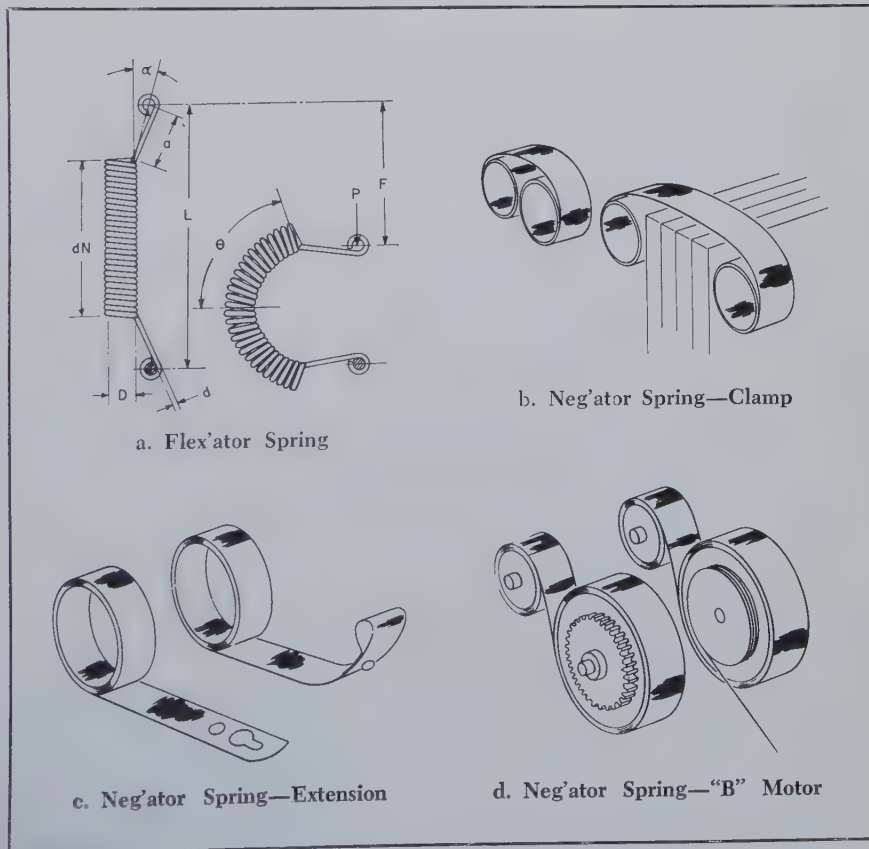


FIGURE IV-3. Constant Force and Torque Springs.

neg'ator / APPLICATION WORKSHEET

SPRINGS • MOTORS • CLAMPS

Date _____

Company _____ Name _____
Address _____ Title or Dept. _____
City & State _____ Phone _____

A. PROPOSED NEG'ATOR APPLICATION

1. Product _____

2. Function of NEG'ATOR unit _____

☐ This function is new.
☐ NEG'ATOR unit replaces _____

3. NEG'ATOR unit to be used as . . .

☐ Extension spring



☐ Motor



☐ Clamp



☐ Other

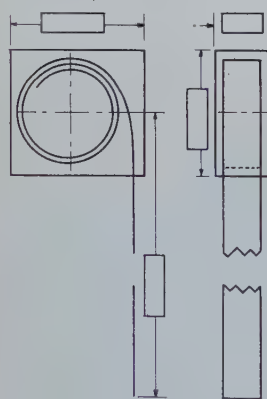
B. NEG'ATOR SPRING REQUIREMENTS

- Load _____ (lb) or torque _____ (lb-in)
- Length of stroke _____ (in) or revolutions _____ (degrees) (turns)
- Speed required _____ (in./min) (rpm)
- Service life _____ (no. of complete and/or partial cycles or operations)
- Temperature conditions _____
- Corrosive conditions _____
- Other special conditions _____
- Remarks _____

SPECIFICATION REQUIREMENTS FOR PROPOSED NEG'ATOR SPRING APPLICATION

A. EXTENSION SPRING

1. Dimension Requirements or Limitations.



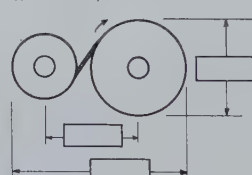
2. End Configuration (suggestion).



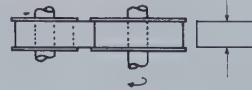
length of straight tail (if required) _____ in.
(Check NEG'ATOR engineering for specific dimensions and available tooling).

B. MOTOR

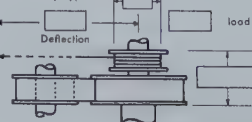
1. Dimension Requirements or Limitations.



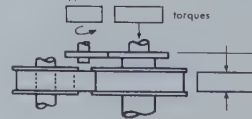
2. Shaft Type



3. Pulley Type



4. Gear Type



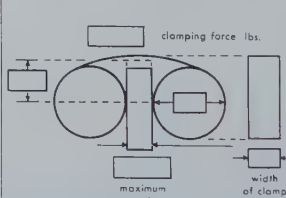
5. End Configuration

Check NEG'ATOR engineering for specific dimensions and available tooling.

C. CLAMP

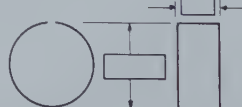
1. Double-Loop Type

Dimension Requirements or Limitations.



2. NEG'ATOR Band

Max. opening _____ in.



REMARKS

SKETCH OF PROPOSED APPLICATION

CONSTANT FORCE AND TORQUE SPRINGS

THE fifth category of springs is the constant force spring. This flat band category includes the extension spring and motor (Neg'ator) and the helical compression spring (Flex'ator); see Figure IV-3.

The "Neg'ator" is a prestressed strip of flat spring stock which coils tightly about a bushing (or successive layers of itself) and exerts a constant restraining force when uncoiled. A recommended spring specification form for verbally specifying the three most common forms of "Neg'ator" springs—extension, motor, and clamp—is shown in Figure IV-4. Both the extension spring and the motor spring should be specified, not only in terms of maximum or minimum coil OD and band width, but also by a detailed drawing of the developed end, where punching or die cutting or any special forming is required.

The "Flex'ator" is an elastic device which incorporates deflection through flexing, maintaining a constant force resisting compression. It consists of a close-wound, highly initial-tensioned spring body with equal arms extended at a slight angle to the body. The arm ends are usually formed into loops or bent at right angles to the body. There is no recommended specification form for the "Flex'ator." Cataloged, standard designs offered by the manufacturer are recommended where available and identified by part number. Designs departing from those in the catalog should be drawn and fully dimensioned.

Next month we present Part VI, the concluding instalment of this important series on Spring Drafting.
—The Editors.

The Authors

ALBERT L. GODSHALL and GERALD L. KILMER are Chief Draftsman and Spring Design Engineer, respectively, at Hunter Spring Company, Division of American Machine & Metals, Inc., Lansdale, Pa.

(To be concluded)

FIGURE IV-4 (Sheets 1 and 2). Recommended Neg'ator spring specification form.

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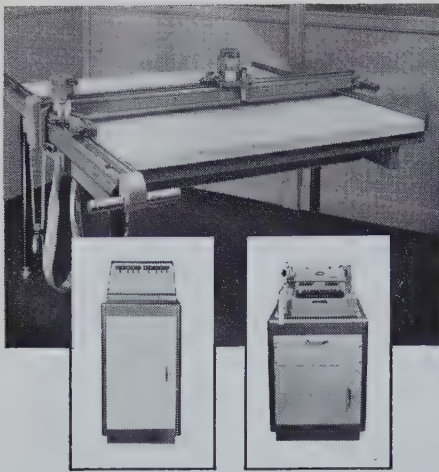
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Washable Drawings Meet Government Specification

by William N. Bahrikis

THE U. S. Army's surface-to-air HAWK, and the U. S. Navy's air-to-air SPARROW are produced by Raytheon's Missile Systems Division, Bedford Laboratories, Bedford, Mass. In order to fulfill the requirement of our military contracts, which state that reproducible master copies must be supplied to the Government, it was necessary—when tracing paper was used—to establish a file of secondary master sepias of the originals for every-day reproduction purposes.

We faced staggering expenses each year in the restoration of engineering drawings, accomplished both photographically and manually. This situation was brought about because our drawings—on conventional tracing paper and tracing cloth—were subject to extended revision, handling and filing. The build-up of surface dirt was rapid. In some instances, a drawing would become too soiled and abused to produce a readable print in less than three months.

A Drafting Practices Committee was set up in 1958, charged with the responsibility of selecting a drafting material sufficiently durable to retain reproducibility under extended usage. Under the leadership of Don Sherman, manager of the Product Design Branch of the Bedford Laboratories, a sub-committee was established to explore this problem.

We had heard via the trade "grapevine" that a major East Coast aircraft firm was experimenting with "wash methods" using a polyester-based drafting film*, together with a special

pencil* that deposited a plastic, rather than a graphite line.

We decided to investigate. The first thing to be established was that the plastic pencil and polyester-based film constituted a satisfactory drafting combination. Various types of drawings were made and printed. The produced first-rate copies. We then dirtied originals made with plastic pencil on film until they were barely legible, and completely unprintable. These were washed with soap and water; the drawings remained intact.

Next we made tests for reproducibility of the washed drawings. Our manager of Engineering Records, T. Giatas, directed these tests. Prints made from drawings after several washings were found to be as clear as prints obtained from fresh drawings. We wrinkled and creased sheets of the polyester-based film, smoothed them out and printed. To our surprise, usable prints were still obtained.

To determine how much abuse to surface could withstand, we (1) taped a sheet to the floor where it was walked on and rolled over by a swivel chair; (2) baked a sheet in an oven and immediately subjected it to extreme cold; (3) poured scalding coffee on a film drawing and let it stand for two hours. In each case, after soap-and-water washing, the drawings were still reproducible, the pencil lines intact and legible.

These tests convinced the Drafting Practices Committee that the polyester-based film and plastic pencil combination was the most economical medium for our drafting room, despite the fact that its initial cost is about four times that of good tracing paper.

Unexpectedly, however, we met resistance from our draftsmen. They complained that the lines produced by the plastic pencil were not de-

*The washable drafting medium used was HERCULENE Drafting Film, manufactured by Keuffel & Esser Co., Hoboken, New Jersey, on a base of Du Pont Mylar® polyester film.

**The washable pencil line was made by DURALAR pencils, developed by J. S. Staedtler, Inc., Hackensack, N. J., especially for use on drafting films.



nough, that the points were more apt to break, that the lines were difficult to erase, and that the pencils had a "crayony" feeling.

We asked these men to use the new materials for a month. If they were still dissatisfied at the end of that period, we promised to try and find another solution to our problems. As we had hoped, complaints dwindled rapidly as the men became accustomed to the new medium. Our draftsmen are now highly pleased with the results they are getting.

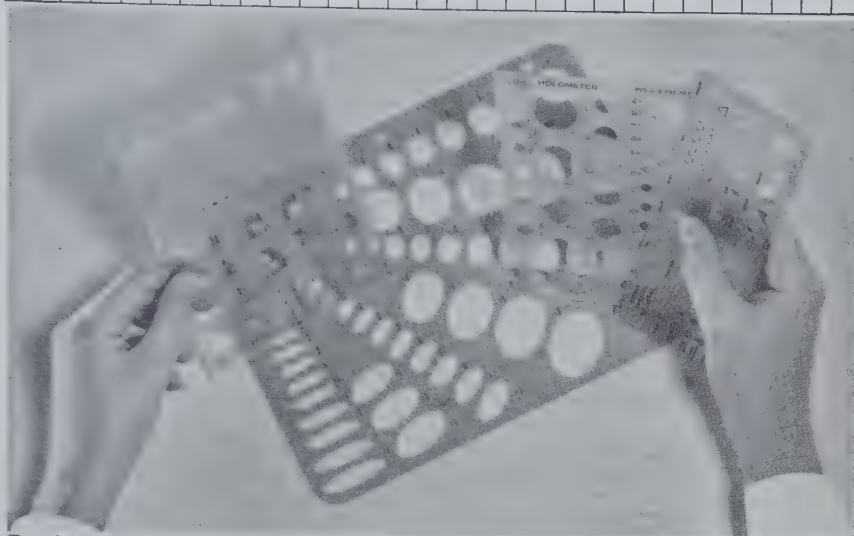
In addition to eliminating re-draws, use of the polyester-based film has brought other benefits. Quality of reproduction has greatly improved. Also, as stated earlier, we are able to fulfill the requirement of our Military contracts in supplying reproducible master copies made at the outset of a project on the polyester-based film. When final plans are filed with the Government, these drawings are still in excellent condition—despite daily use for normal reproduction purposes.

We have also saved money by reducing our stockpile of drafting media. Previously, paper was needed for pencil drawings, cloth for inking, and film for specialties—such as printed circuits and templates. All of these requirements are now handled by the film, which can also take graphite, ink, or typing. Our experience indicates that polyester-based drafting film would be a wise investment for any firm engaged in drafting.

The Author

WILLIAM N. BAHRIKIS is Drafting Section Head, Product Design Branch, Bedford Laboratories, Missile Systems Division, Raytheon Co., Bedford, Mass.

DRAFTING TRENDS



Drafting Templates are a valuable tool to faster drafting. They are available in an almost endless variety.

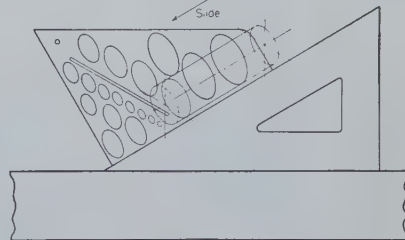
Specialized drafting templates speed drawing time

Always a handy tool, drafting templates are becoming increasingly in use to simplify everyday drawing techniques. Now vinyl plastics are used in the manufacture of the majority of templates. But the thickness, color and finish vary in almost endless profusion. Glare-saving colors, such as green and amber, are usual, both in clear and matte finishes. However, the white and clear plastics still are popular. The thicknesses vary with the different types of available templates from .020 gauge through .070 gauge.

Specialized template applications

A list showing the growing application for templates includes templates for: Electronic Symbols, Electrical Wiring, Landscaping, Screw Heads, House Plans, Nuts and Bolts, Screw Threads, Tooling, Windows, Plumbing, Mathematical Symbols, Map Planning, and many "all-purpose" templates for circles, ellipses, triangles, and other shapes.

Isometric ellipse template is a big timesaver



An isometric ellipse template may be more useful if it is cut in half to provide edges parallel to the minor axes of the ellipses. Halves of the template may then be moved along a 30-60 degree triangle so that ends of a shaft or any cylindrical shape can be drawn in a minimum of time and in perfect alignment.

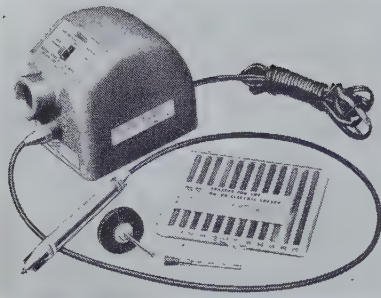
A selection of 52 popular templates is illustrated and described in a special six page brochure, "Drafting Templates" recently published by Frederick Post Company. For your copy, write Frederick Post Company, 3656 N. Avondale Ave., Chicago, Illinois.



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Pencil Point Cleaner



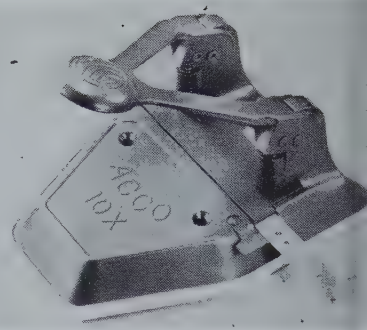
Graphite dust remover, consisting of a fiberglass pad into which the pencil point is inserted and—with a twist or two—cleaned and smoothed, is offered by Kleenpoint Leadkleener Mfg. Co., 2009 Thomes Ave., Cheyenne, Wyo. The Kleenpoint Leadkleener is designed to be mounted on standard types of pencil sharpeners and pointers. Pen points and ruling pens may also be cleaned with the device.

Electric Eraser

Revisions on drawings, layouts, off-set plates, typewritten material, etc., can be made efficiently with a lightweight erasing unit. Called the Presto No. 80 Electric Eraser, the device is manufactured by Metal Specialties Mfg. Co., Melrose Park, Ill. According to the manufacturer, high-speed rotation of the $\frac{1}{8}$ -inch diameter eraser, permits erasing on Mylar. Supplied in three grades, for pencil, plastic pencil, ink, or ball-point pen.

Tinted Film for Slides

Film that is sensitized with a high-quality, black, dry-developing diazo coating on a .005-inch tinted acetate base, has been announced by Ozalid Division, General Aniline and Film Corp., 39 Corliss Lane, Johnson City, N. Y. Called Tinted Viewfoils, the films are said to give top quality color reproduction and to permit a wide range of special effects.



Two-Hole Paper Punch

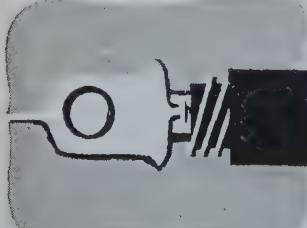
Paper punch, designed to cut two $\frac{1}{8}$ -inch holes, $2\frac{1}{4}$ -inches center-to-center, is offered by Acco Products, Division of Natser Corp., Ogdensburg, N. Y. This improved Acco 10X two-hole punch is said to be very accurate; the gauge locks in place to align paper to be punched. A removable plastic tray at the base catches the perforation cut-outs; this unit also protects the desktop and provides a firm foundation when punching.



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New Products

Photo-Sensitized Cloth

Reproduction cloth said to possess markedly improved physical strength and wearing properties, as well as superior photographic characteristics has been introduced by Peerless Photo Products, Inc., Shoreham, L. I., N. Y. The specially woven base material is treated with a waterproof lacquer coating that adheres to the cloth and at the same time provides a base with the right amount of "tooth" to receive and grip the photo-sensitive emulsion. The plastics coating is said to give a smooth drawing surface with good pencil and inking qualities on both sides, but also one that minimizes dirt.

Four-Bevel Scales

Plastic scales with four beveled edges for architects and engineers have been introduced by The C-Thru Ruler Co., 827 Windsor St., Hartford, Conn. The architects' scale is graduated in fraction of the inch to the foot. The engineers' scale is graduated in decimal points to the inch.

Perspective Ruler

A ruler, said to permit the drawing of receding lines to vanishing points, each automatically and accurately directed, is available from Canlen Co., 1239 Monroe Ave., Wyomissing, Penna. Called Perspect-O-Rule, the unit may be used for the construction of two-point perspectives. According to the manufacturer, Perspect-O-Rule's measurements are accurately pre-calculated. Any scale can be selected depending on the nature and size of the drawing. The plastic straightedge is available in three different sizes, for making drawings from 15 inches to 26 inches in width.

Reproducing Ball Pens

Writing instruments recommended for use on Diazo, Photocopy, Verifax, Thermofax, Xerography and offset processes have been introduced by Eberhard Faber Pencil Co., Crestwood, Wilkes-Barre, Penna. In meeting these special requirements, the Fotorite Pen is said to retain all of the outstanding qualities of other Noblot ball pens. It has the extended writing tip, the extra-long cartridge, a fluted cone, and plastic point-protector in a color to match its ink. Blue, red, and black ink colors are offered.

Nylon Sliding Tape

An introductory "industrial pack" designed to acquaint drafting personnel, plant managers, and others, with self-adhering, solid nylon, sliding tape (Nyl-O-Tape) is available from Hardware Designers, Inc., P.O. Box 4, Hackensack, N. J.

(For additional information regarding the new products described here, contact the manufacturer directly. Complete addresses are included.)

GRAPHITE OR PLASTIC?

We don't have any figures on it, but we'd be willing to bet that "plastic" pencils have soured more draftsmen on film, than all other factors combined.

Time and again chief draftsmen have told us of cases where their draftsmen refused to use film when it was tested with "plastic" pencils, but who later welcomed film with open arms when matched with F. T. R. Pencils. Results: F. T. R. Pencils eased the change-over and made film more practical.

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Write for free samples and information. The Joseph Dixon Crucible Co., Technical Research Dept., Jersey City, N. J.

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Drafting Machine

*Rigid beam rails support accurate
unit easy to use at any board angle*

DRAFTING CONVENIENCE, ease of operation and accuracy are said to characterize a new drafting machine that is designed to fit any size board. The 60 Tracmaster, recently introduced by Universal Drafting Machine Corp., 7960 Lorain Ave., Cleveland 2, Ohio, is automatically balanced for use at any board angle. It can lock to a point in one elevation, and carry this point vertically or horizontally to another view. Its rigid horizontal and vertical beam rails provide true tracking, straight line, and parallel accuracy. These rails are rigid enough not to sag or deflect, nor to require intermediate board supports. The guide rail, located in the center of the beam, is enclosed by endless nylon tape to protect the rails from dust and erasures.

According to the manufacturer, less than eight ounces of pressure will move the 60 Tracmaster's protractor to any position on the board, at any board angle. Because of the design, this is accomplished with no swinging weight arm, requiring extra space. A new protractor height adjustment reduces board friction by allowing only the scales to touch the drawing. The protractor swings up and out of the way to clear objects, and to permit insertion of drawings. Universal's Boardmaster ball-bearing protractor is also a Tracmaster feature.

An optional accessory, useful for high-level accuracy and drafting speed, is 10-inch numbered grid graduations, engine-divided along both X and Y beams. A mechanical V-nier magnifier permits repetitive settings to within less than .010-inch. Mounting brackets are designed to fit any drawing board without adjustment, and to automatically set the proper height of the Y-beam. 60 Tracmasters are available for all standard-size boards, and on special order for boards up to 96 inches wide. These machines may also be obtained in special left hand models, and with Civil Engineering protractors.





The Book Shelf

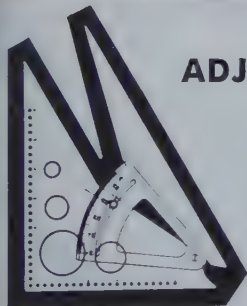
ELECTRICAL AND ELECTRONIC DRAWING, by Charles J. Baer, McGraw-Hill Book Company, Inc., New York, 1960 (\$6.00)

IF YOU ARE a draftsman or a supervisor of draftsmen who must make electrical or electronic drawings, you ought to have Professor Charles J. Baer's authoritative new book within easy reach. Now at last you have readily available in one slender volume a comprehensive picture of the entire electrical drawing field.

Professor Baer has done much more than simply report the established and the more recently adopted symbols and the best practice, important as all these things are. In addition, he has given just enough clear, practical information to provide insights into the meaning of the symbols. As a result a draftsman begins to feel that he understands the electrical and the electronic elements, and therefore the arrangements of circuits seem less mysterious. Then each chapter is neatly summarized in

(Continued on page 32)

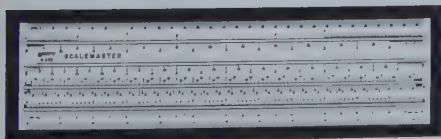
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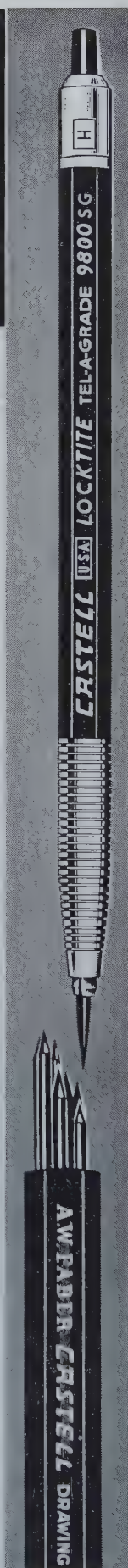
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(Continued from page 31)

a short paragraph to highlight the more important features in each section. Add to all this illustrations that are models of drawing—the author is a professor of drawing—and you have a virtually indispensable tool for the drafting room.

A few examples of the timeliness of the book are automation circuits, Explorer satellite circuits, and etched circuit drawings. Equally interesting and modern are the major chapter headings:

Electrical and Electronic Symbols
Wiring, or Connection, Diagrams
Block Diagrams
Electronic-tube and Transistor (semiconductor) Symbols
Electronic Schematic Diagrams
Industrial Electronic Diagrams
Electric Power Drawing
Electrical Drawing for Architectural Plans

There are three other chapters; one dealing with lettering, one with introductory material on pictorial drawing, and one with graphs. The chapter on graphs—how, why, and when—is very useful: brief, succinct, carefully illustrated with all examples drawn from electrical and electronic fields. The nine-page Appendix displays electrical symbols for architectural plans, semiconductor symbols, symbols for schematic and wiring diagrams; it is so well done that by itself it's worth the price of the book.

And this is not all! In addition to the summaries at the ends of the chapters there are 150 questions and 100 practical problems. Any draftsman who wants to gain competence or increase his proficiency in this field will find lots of opportunity to learn if he accepts the challenge of the questions and the problems.

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New Literature

Micro-Mechanized Engineering Data and Automated Logistics (MEDAL) Program of the U. S. Air Force, a brochure (AF-WP-O-FEB 59 5M), has been published by the Cataloging and Standardization Division of the Air Force. This publication is intended solely to acquaint Air Force and other interested activities connected with the engineering drawing program, with the purpose, scope and main features of the newly developed MEDAL Program. Section 1 gives the background of Air Force microfilming, describes the experimental program and the approved MEDAL program, and states its advantages. Section 2 deals with equipment requirements as follows: Microfilm cameras, Viewing Equipment, High-Speed Microfilm Projection Printer, Printer-Processor-Viewers, Semi-Automatic Mounter, Low-Speed Duplicator Printer, High-Speed Card-to-Card Printer, Punchcard Accounting (EAM) Machines, and Filing Equipment. Copies of this publication may be obtained from Commander, Headquarters, Air Materiel Command, Attention: MCSIF, Wright-Patterson Air Force Base, Ohio.

Pressure Vessel and Piping Design, a monumental compilation of basic information for designers of boilers, pressure vessels and piping systems, has been published by The American Society of Mechanical Engineers. The 100-page volume is priced at \$10.00. Copies may be obtained from Order Dept., ASME, 29 West 39th St., New York 18, N. Y.

Photodrawings Brochure (5M 10-59), containing information on LogEtronic Model enlargers, and the reasons why this equipment can produce superior photodrawings, may be obtained without charge by writing to LogEtronic Inc., 500 East Monroe Ave., P.O. Box 2098 Potomac Station, Alexandria, Virginia. The brochure also gives information on the uses and applications of photodrawings, and some time and cost data.

(Copies of the literature reviewed can be obtained directly from the manufacturer or publisher. Complete addresses are included.)

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BLU-RAY

WHEN OUR publishing life began, in October of 1959, there were those among our friends and advisors who expressed doubt as to whether there was really anything new to write about in drafting rooms or in the procedures followed therein.

"It's an individual matter, this business of working out a design," they told us. "Equipment? T-square, triangles, high stool, and flat board. Media? Pencil on paper, ink on cloth. Reproduction techniques? Blueprinting. Salary? Minimal. Status? Nil."

The response that greeted the first issue of GRAPHIC SCIENCE—and every issue since—has permanently removed any question as to whether or not there is anything to talk about, or write about, in drafting rooms. Our readers are thoughtful, articulate, informed, and abundantly aware of themselves and of their profession.

Those who work in drafting rooms have been called a good many things—some of them unprintable. We prefer, as the definition of the draftsman, the term of "technical communicator"—a definition proffered by one of our authors. The draftsman is indeed a technical communicator. He is also a specialist, not only in a particular area of design, but as a technician, whose output commands an imposing variety of reproduction tools. He is, ideally, a "man in motion," moving steadily upward in his work from detailer to layout

man to designer. According to another of our authors, industry can no longer afford the "career draftsman." The steady progression from one level of responsibility to the next, he believes, is a necessary part of a personnel policy that provides incentive and rewards ability. Unlike our cartoon friend "Smudge"—whom we fondly encourage to remain the perennial draftsman—the man on the board is a creative and vital individual with opportunity in these United States of America that is perhaps unmatched in any other country in the world.

However, we have also uncovered areas where there is still much to be accomplished in the drafting world.

One of these areas, we have reason to believe, is the equipment with which the draftsman is expected to work, and the physical environment that surrounds him in most U. S. drafting rooms. Surely adequate lighting and a reasonable temperature in which to do "thinking work" are minimal. Yet experts at G. E.'s Nela Park Lighting Institute (see page 15) tell us that they do not know of a single drafting room in the country where 200 footcandles of light—the recommended level of illumination for drafting—is supplied to drafting boards. A number of drafting rooms, we are certain, are air conditioned. Yet we know of firms in New York City where designers work in perspiring discomfort, with city heat and soot pouring in through

open windows, while the errand breeze scatters prints and paper about. As to equipment, we have on good authority that U. S. industry lags to an alarming extent in providing up-to-date boards, chairs, and machines; this despite the fact that the effect of good equipment on drafting output and efficiency has been substantially documented (see page 19).

While the hue and cry continues regarding the merits of function in drafting as a cost-reduction factor, while short-cut reproduction techniques are assiduously investigated while large corporations endow universities with generous engineering scholarships, and while drafting room management pursues extensive on-the-job training programs (see GRAPHIC SCIENCE for July), a large factor in recruiting and holding drafting personnel and in cutting costs—that of optimum working conditions—is largely neglected. Today's draftsmen, it has been said, are in too many cases expected to work with "Stone Age tools."

We believe that the essential nature of the work performed in the nation's drafting rooms warrants the best possible working conditions. To this end we have presented in the foregoing pages, some of the current thinking as to what constitutes optimum working conditions for draftsmen.

E. W.

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MODEL NO. 3065: A new model with 7 interchangeable drawing point sections, each color-coded to indicate a different line width. Best buy for the professional who requires frequent change of line widths. Each drawing point section complete with airtight refillable ink cartridge. Interchange is accomplished quickly, cleanly. Comes in handy desk top container.



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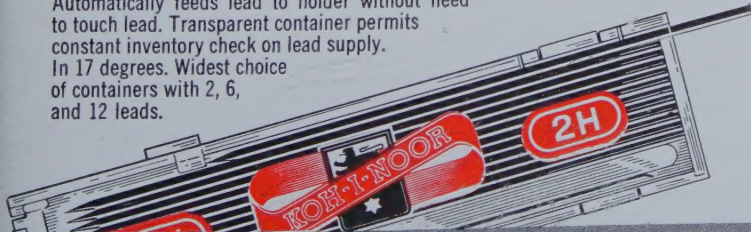
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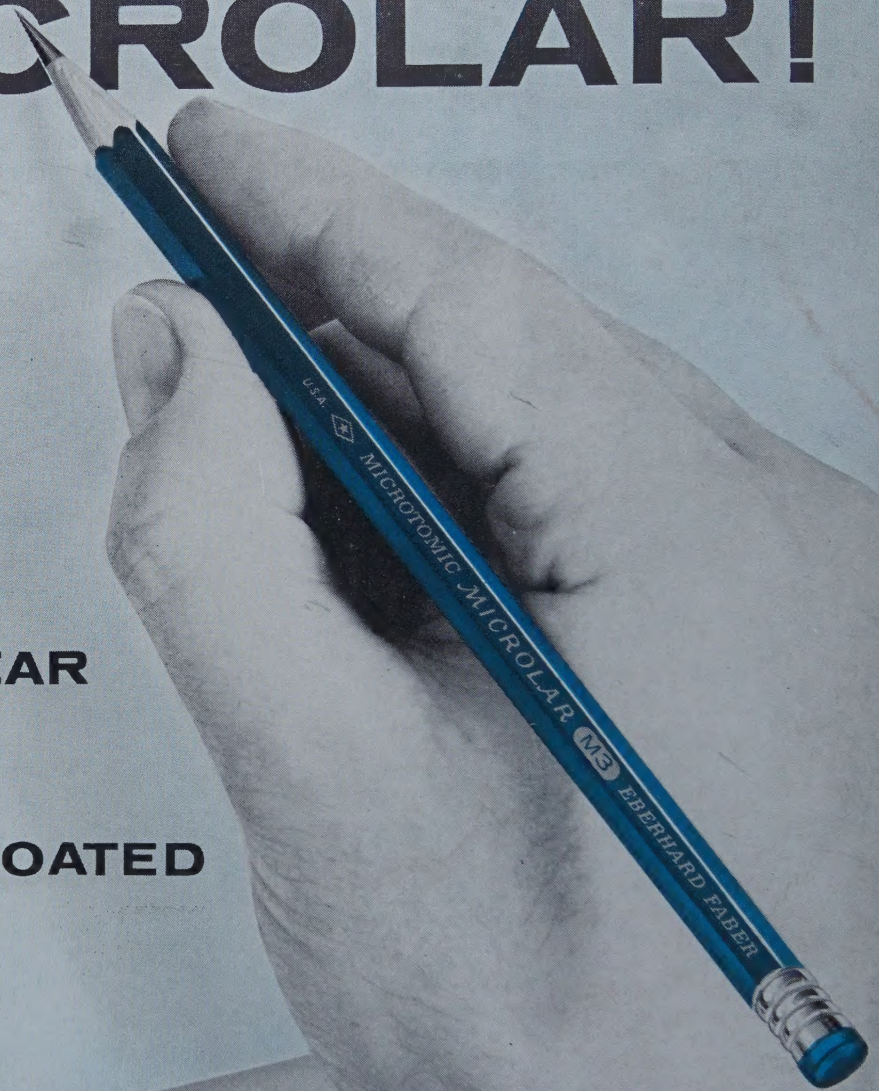
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